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# ENVIRONMENTAL ASSESSMENT

Cyprus Industrial Minerals Company

Amendment 005 to Operating Permit 00005

Yellowstone Mine

Prepared by

Montana Department of State Lands

July 30, 1990

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# CHAPTER I - INTRODUCTION

## A. Purpose and Need

Cyprus Industrial Minerals Company (CIMC) has applied to the Department of State Lands (DSL) for approval of an amendment to its existing Yellowstone Mine (Operating Permit No. 00005). The amendment, if approved, would provide for the production of talc for another eight years. This environmental assessment (EA) has been prepared to analyze the impacts associated with the amendment as proposed. In addition, reasonable alternatives have been identified and evaluated. The information presented in this document, as well as in the application and public comment will be used to formulate a decision to approve, approve with modifications, or deny.

CIMC currently operates an open pit talc mine at its Yellowstone Property in Madison County, Montana. The Cyprus Yellowstone Property is situated in the east foothills of the Gravelly Range, Madison County, Montana (Figure 1). It is located in Section 4 and part of Section 5, Township 9 South, Range 1 West. An office/shop complex and sedimentation ponds are located in the southeast corner of Section 34, T8S, R1W and the northeast corner of Section 3, T9S, R1W. CIMC currently has applied for amendment 004 to Operating Permit 00005A. The amendment is for an eight-year mine plan within a total resource base of approximately 30 years.

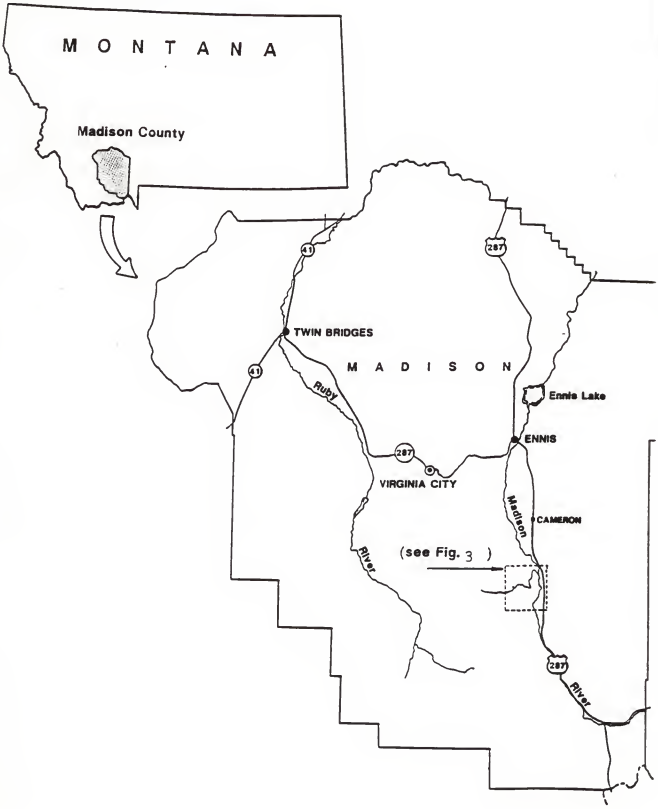
CIMC has compiled existing permit information, incorporated new operating design to address current and anticipated operations at the Yellowstone Mine, and presented a detailed reclamation plan complementary to the proposed operating plan and submitted the comprehensive plan to the Department of State Lands (DSL) on May 26, 1989.

## B. Permitting History

CIMC has operated the Yellowstone Mine in Madison County, Montana, since 1950. On December 21, 1971, CIMC was issued Hard Rock Operating Permit No. 00005 by the DSL. In 1976, CIMC requested an increase to the permitted area in order to 1) install a new pit sorter facility, 2) expand waste dumps, and 3) mine additional reserves of talc. A Preliminary Environmental Review (PER) was issued on the 1976 expansion and operating permit 00005A was approved on March 3, 1977. On July 23, 1981, CIMC was granted amendment 001 to Operating Permit 00005A, bonding an additional 158 acres to allow for construction of a new pit sorter facility and waste dump for this facility.

In 1986, CIMC submitted an amendment to Operating Permit 00005A requesting an additional 180 acres, 125 acres for the Johnny Gulch waste dump and 55 acres for a crude ore storage facility. A PER was written and amendment 002 to Operating Permit 00005A was approved September 24, 1986. On September 22, 1987, CIMC requested an amendment to expand the South Dump into Johnny Gulch. DSL agreed that CIMC could address the permit amendment deficiencies in separate phases. The first phase, the extension of the South Dump, was submitted April 6, 1988, and a PER was prepared and Amendment 003 to Operating Permit 00005A was approved August 2, 1988. The present submittal addresses the

Figure 1. Location of the Yellowstone Mine



tailings impoundment, flotation mill and permit boundary expansion to include office and shop facilities.

CIMC is mining federal and privately-owned minerals on private lands. One exception is 40 acres (NE¼NE¼ Section 4, T9S, R1W) of federal surface included in the permit boundary but not disturbed by mining activities. The total permit area proposed is 1,223 acres. Total disturbed acreage would be 539 acres. Production would be 880,000 tons per year. Overburden would be 3,180,000 tons per year. Employment of 110 at the mine would not change under this amendment.

Examination of Department of Health and Environmental Sciences (DHES) Water Quality Bureau records, and discussion with Fred Shewman indicate that the CIMC Yellowstone Mine is not required to have a Montana Pollution Discharge Elimination System (MPDES) permit.

Air Quality Permit No. 1648 was issued to CIMC for the Yellowstone Mine in January 1982. Monitoring was conducted as stipulated in the air quality permit for one year following installation of the new pit sorting facility, and was discontinued in December 1984. Since proposed changes in the operation would increase emissions, a new air quality permit (No. 1648-A) was prepared and issued September 21, 1989, which includes new air monitoring requirements.

C. Related Actions

Mining for talc is being conducted upstream of the Yellowstone Mine at the Montana Talc Company is Johnny Gulch Mine, under Operating Permit No. 00127.

Additional exploration for talc has been conducted in the surrounding area; however, no other mining has been proposed to date. Any expansions of either the Yellowstone Mine or the Johnny Gulch Mine, as well as any new mines in the area, would be subject to another environmental review at the time of application for an operating permit.

D. Agency Responsibilities

1. Department of State Lands

The Commissioner of State Lands must decide whether to: (1) approve the amendment as applied for, (2) approve the CIMC proposal with modification, or (3) deny the amendment, consistent with the requirements of the Montana Metal Mine Reclamation Act (MMRA) Title 82, Chapter 4, Part 3, MCA.

DSL administers MMRA. The purpose of the act is to recognize and protect the usefulness, productivity and scenic values of the lands and waters within the state and to reclaim to beneficial use the lands used for mining. The act and its regulations (ARM 26.4.101 et seq.) set forth the steps to be taken in the issuance of an operating permit for and the reclamation of the applicant's proposed mine expansion. The act applies to private, federal and state lands within Montana.

DSL is also responsible for administering the Montana Environmental Policy Act (MEPA) (Title 75, Chapter 1, MCA) relative to mining questions. These rules, ARM 26.2.60? et seq., require environmental analysis of mining applications. The Department has determined than an Environmental Assessment (EA) is appropriate for this project. This EA has several purposes:

a. It serves to ensure that the agency uses the natural and social sciences in the environmental design arts in planning and decision-making;

b. It assists in the evaluation of reasonable alternatives and the development of conditions, stipulations or modifications to be made a part of a proposed action;

c. It determines the need to prepare an EIS through an initial evaluation and determination of the significance of impacts associated with a proposed action;

d. It ensures the fullest appropriate opportunity for public review and comment on proposed actions, including alternatives and planned mitigation, where the residual impacts do not warrant an EIS; and

e. It examines and documents the effects of a proposed action on the quality of the human environment, and provides the basis for public review and comment.

2. Bureau of Land Management

The Bureau of Land Management (BLM) is responsible for preventing unnecessary or undue degradation of federal lands under regulatory provisions in 43 CFR 3809. Federal regulations at 43 CFR 3809.3-1 provide for a joint federal-state regulatory program. Such a program was initiated on April 30, 1984, by a Memorandum of Understanding (MOU) between the BLM and DSL. Under the MOU, both agencies have participated in the review of this amendment. In addition, the BLM has responsibilities under the National Environmental Policy Act (NEPA) similar to DSL's responsibilities. This EA will also fulfill those NEPA responsibilities.

3. Other State Agencies

a. State Historic Preservation Office

The State Historic Preservation Office (SHPO) is responsible for cooperating with and advising DSL when potentially valuable historical, archaeological, or other cultural resources are located within a project area (Montana Antiquities Act Sections 22-3-401 through 22-3-442, MCA, and the National Historical Preservation Act [P.L. 89-665 as amended and reauthorized E.O. 11593]). Advice given to DSL may include comments on an applicant's plan for impact mitigation of sites eligible for nomination to the National Register of Historic Places. The office also reviews the EA or EIS to ensure compliance with cultural regulations.

The State Historic Preservation Office issues antiquities permits for projects on state lands. The office also seeks determinations from the Keeper of the National Register for sites believed eligible for listing on the National Register of Historic Places. During mine operation, DSL is responsible for monitoring compliance with historic preservation and monitoring plans.

No additional surface area, not previously in compliance, would be disturbed under this proposal. Therefore, no cultural resource compliance activities are being evaluated in this EA.

b. Department of Health and Environmental Sciences (DHES)

i. Air Quality Bureau (AQB)

The Air Quality Bureau of DHES administers the Clean Air Act of Montana (Title 75, Chapter 2, MCA). Any proposed project with potential to emit more than 25 tons per year of any pollutant must obtain an air quality permit prior to construction. The applicant must apply Best Available Control Technology (BACT) to each emission source. The applicant must also demonstrate that the project would not violate Montana or Federal Ambient Air Quality Standards. Any increase in emissions at a previously permitted project requires a permit alteration.

ii. Water Quality Bureau (WQB)

The Water Quality Bureau of DHES is responsible for administration of the Montana Water Quality Act (Title 75, Chapter 5, MCA), providing for the classification of surface waters, establishing surface water quality standards, and administering permit programs to control the discharge of pollutants into state waters.

A Montana Pollutant Discharge Elimination System (MPDES) permit must be obtained before any discharge to surface water may occur. The MPDES permit contains water quality limitations and requires self-monitoring of effluent by the permittee. Mining operations must also comply with Montana groundwater standards.

4. Department of Natural Resources and Conservation (DNRC)

DNRC administers two statutes that are applicable to mining development in Montana. These are the Montana Major Facility Siting Act (Title 75, Chapter 20, MCA (MFSA) and the Montana Water Use Act (Title 85, Chapter 2, MCA (MWUA). The MFSA requires state approval before construction of any electrical transmission line that exceeds 69 kilovolts (kV) or 10 miles in length. A water rights permit is required by the MWUA for any surface water diversion or groundwater withdrawal exceeding 100 gallons per minute. Total proposed water use for this project is 9.5 - 20 gallons per minute average daily use. This requirement is met from a series of groundwater wells. No additional electrical transmission lines or water rights are proposed or necessary for the implementation of this amendment.

5. Hard Rock Mining Impact Board

The Hard Rock Mining Impact Board created by the passage of the Hard Rock Impact Act (Title 89, Chapter 6, Part 3, MCA) is attached to the Montana Department of Commerce for administrative purposes. A quasi-judicial board, it is intended to act as a "referee" in hearing disputes between local government units and large-scale mineral developers over the impact mitigation plan prepared by the developer. In the impact mitigation plan, the developer identifies the increased public sector costs associated with major mineral development and commits to pay, according to a specified time schedule, all increased capital and net operating cost to local government units resulting from development. With a projected work force of 165, CIMC's Yellowstone mine and mill would have met the definition of a large-scale mineral developer; however, it was permitted prior to the effective date of the act and was grandfathered from compliance.

## CHAPTER II - EXISTING ENVIRONMENT

### A. Geology

Topography in the project area ranges from gently sloping in the northeast to quite steep toward the southwest (Figure 2). Elevations range from about 5,730 feet Mean Sea Level (MSL) in the northeast to about 6,800 feet in the north central, with the mine elevation approximately 5,950 to 6,400 feet. The main drainage through the project area is Johnny Gulch; the deeply incised Ruby Creek Gulch is about one-half mile to the southeast. Both are tributary to the Madison River, about three miles east of the project area.

The Yellowstone Mine is located within a 2 x 4-mile outcrop of isoclinally folded, Precambrian dolomitic marble. The marble has a westerly contact with Precambrian Gneisses, an easter contact with Precambrian phyllites, a southerly unconformable contact with Paleozoic sediments, and a northerly unconformable contact with Quaternary gravels. Tertiary and Quaternary volcanic rocks overlie the marble in areas of paleogeomorphic depressions and grabens. Dolomitic marble in the mine area comprises the east limb of a large, southwest-plunging syncline.

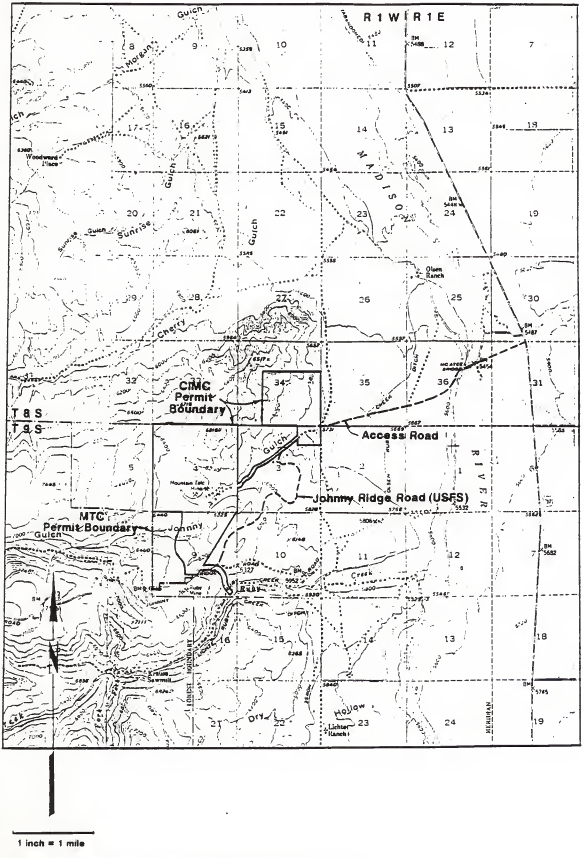
The Precambrian dolomitic marble is a resistant rock unit that has a northerly strike ridge as its geomorphic signature. Three steeply dipping basement fault systems are geomorphically expressed as scarps or grabens. The north and the northwest-trending fault systems were reactivated during Tertiary volcanic activity. Quaternary reactivation of a third fault system is indicated. Quaternary gravels covering the marble's northerly outcrop also conceal the major range-front fault system on the west side of the Madison Valley. The east scarp of the Madison Valley indicates Pleistocene activity. Landslide potential from seismic activity is nonexistent in the mine area.

Talc was formed by metamorphic reactions in the Precambrian dolomitic marble. Talc veins are highly variable in size. Talc color ranges from light green to yellow to pink, depending on type and percent of iron and manganese present. Individual veins consist of 90 to 100 percent talc, 2 to 10 percent dolomite, 1 to 2 percent chlorite, and 0 to 2 percent quartz veinlets. The talc is free of tremolite and toxic metals.

### B. Hydrology

Johnny Gulch, originating on the east flank of the Gravelly Range, is an elongated east-west trending basin. The Johnny Gulch drainage above the mine shop encompasses approximately nine square miles. The upper segment of Johnny Gulch is a perennial stream and the lower segment is ephemeral. The lower portion of the basin has sparse hillside vegetation, while the upper portion is timbered on north-facing slopes and sparsely timbered on south-facing slopes. The upper portion of the basin receives a considerable amount of snow during winter.

Figure 2. Access to the Cyprus Yellowstone Talc Mine



### 1. Water Flows and Pond Water Levels

Flow records were obtained for station F-1 until September 24, 1981, when the station became inoperative due to freezing (Figure 3). Average flow at station F-1 was 93.5 gallons per minute (gpm) for the period May 1 to September 24, 1981. A lower flume (F-2) was installed below Pond 6 on the ephemeral reach of Johnny Gulch. Flow occurred at station F-2 for 23 days during the period May 1 to November 17, 1981. Maximum daily flow at station F-2 was 60 gpm on May 25, 1981.

Locations of eight small ponds in the Johnny Gulch drainage are shown in Figure 3. Pond 1 was the only pond that contained water year-long. Pond 2 contained water during most of the year. Pond 2 contained water during most of the year. Pond 3 had been washed out and did not effectively impound water, therefore was not monitored. Ponds 4, 5, 6, and 7 occasionally contained water, and Pond 8 was not observed to contain water during the period of study. Ponds 4, 5, and 6 downstream from the mine area accumulated appreciable volumes of sediment during spring and early summer 1981.

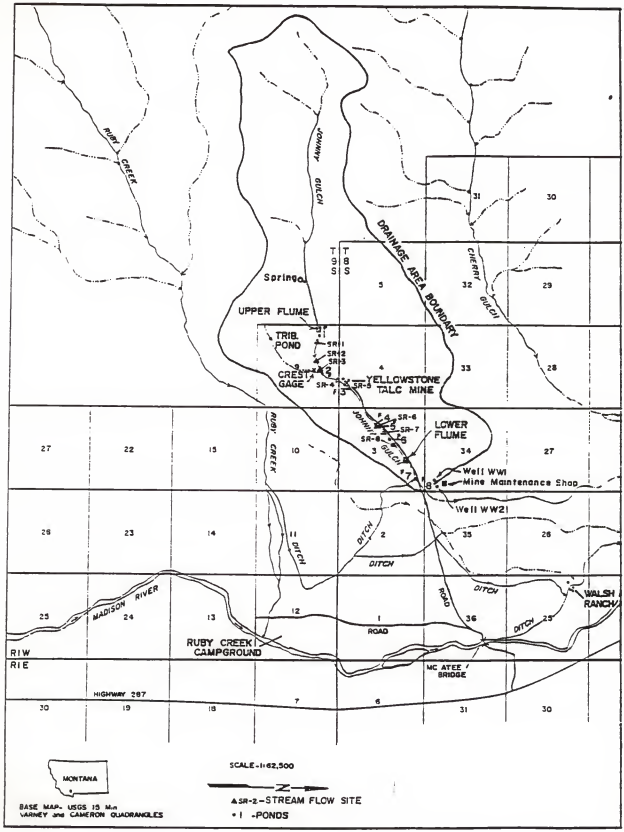
Seepage run data showed that Johnny Gulch loses considerable surface water between pond 1 and pond 2, which apparently seeps into underlying alluvium and may subsequently enter the bedrock groundwater system. These data also showed that the middle and lower reaches of Johnny Gulch are normally dry after spring runoff, and respond only to intense summer and fall precipitation events.

### 2. Water Quality

Water quality in Johnny Gulch is good. Sampling in 1981 showed slight increases in turbidity and total suspended solids through the mine area and pond system. Surface water in Johnny Gulch is a calcium-bicarbonate, non-saline type that meets primary Federal drinking water standards in all samples collected. Secondary Federal standards are exceeded for iron in all samples except the upper flume station (F-1), and are exceeded for manganese in samples from ponds 5 and 7 and from the lower flume site (F-2). Elevated concentrations of iron and manganese are not uncommon in surface waters flowing through areas of igneous and metamorphic rock. Streamflow records indicate Johnny Gulch is a perennial stream to some point above pond 2 and ephemeral downstream from pond 2.

Water samples collected to measure total suspended solids at the upper flume show low concentrations of sediment. Because these samples are not representative of snowmelt or storm runoff, they are not necessarily indicative of annual sediment movement through the Johnny Gulch system. Spring 1981 was unusual in that there was a light snowpack and no significant streamflow events due to snowmelt. Increased concentration of suspended sediment through the mine area observed in May 1981 was due primarily to mine operations and runoff from roads and talc storage piles. Sediment generated in the mine area during 1981 was impounded and deposited in sediment ponds 4, 5, and 6 as well as the Johnny Gulch channel on mine property.

Figure 3. Plan Map of Johnny Gulch Drainage, Madison County, Montana



3. Groundwater in Johnny Gulch

A continuous groundwater system does not exist in the colluvial material or immediately underlying bedrock in Johnny Gulch. Based on the evidence it appears that the gulch is a losing portion of the drainage for both surface and groundwater flow. The seasonal surface flow in Johnny Gulch is almost entirely lost to seepage at about the location of the proposed tailing impoundment.

A water table condition has not been identified in the colluvial material in the gulch or the immediately underlying bedrock. During the 1986 through 1990 period, fifteen drill holes in Johnny Gulch failed to detect a water table condition. Of these holes, three penetrated the colluvium and several hundred feet of bedrock, nine penetrated the colluvium to the bedrock surface, and two penetrated the colluvium but did not reach bedrock.

C. Soils

Available soil and subsoil materials suitable for reclamation have been salvaged during on-going operations since 1950, and are stockpiled.

The area is dominated by strongly faulted and folded Paleozoic sedimentary rocks. Dolomite, ryolite and volcanic tuff are the main rock types in the area. The Montana Department of Natural Resources and Conservation's Draft Environment Impact Statement on the Clyde Park - Dillon 161 and 91 kV Transmission Lines described three natural soil types and one disturbed type in Section 4:

1. Steep mountain and valley side slopes frequently transitional to the valley floors which are established and used primarily in the Gravelly Mountains. Rock outcrops 10-45 percent. Slopes 35-60+ percent. Soils are loamy-skeletal with mixed calcareous and carbonic types. Topsoils are 20 to 40 inches deep. Comprises about 35 percent of Section 4.

2. Moderately steep and steep residual mountain slopes with limestone and other sedimentary bedrock. Rock outcrops 10-25 percent. Slopes 20-50 percent. Soils are loamy-skeletal and mixed calcareous types. Topsoils are 20 to 40 inches deep. Comprises about 20 percent of Section 4.

3. Moderately steep and steep slopes of the mountain flank and strike ridges which are established in the Gravelly Mountains. Rock outcrops (limestone generally) 5-30 percent. Slopes 8-75 percent. Soils are loamy-skeletal, mixed, carbonic family. Topsoils are 20-40 inches deep. Comprises about 20 percent of Section 4.

4. Mode land (miscellaneous land type), the material in this unit is not considered to be a "soil", hence no soil taxonomy is appropriate. Comprises the existing mine area, about 25 percent of Section 4.

## D. Vegetation

### 1. Vegetation Type Descriptions

Six types delineated in the study area included:

| Vegetation Type | Soils | Aspect | Slope |
|---|---|---|---|
| Grassland | Very shallow - moderately deep | Seldom southerly | moderate - steep |
| Big Sagebrush/grassland | Deep, well-drained | Seldom southerly | gentle - steep |
| Low Sagebrush/grassland | Shallow - moderately deep | Seldom northerly | moderate - steep |
| Limber Pine/grassland | Rocky, shallow | All | moderate - steep |
| Douglas-fir | Deep, moist | Mostly northerly | gentle - steep |
| Quaking aspen | Deep, moist | Mostly northerly | gentle - steep |

#### a. Grassland

The grassland type averaged 75 percent cover. Important cover classes were perennial grasses (55 percent cover) and perennial forbs (34 percent cover). Dominant graminoids for three stands sampled were Idaho fescue and bluebunch wheatgrass. Other important graminoids were prairie junegrass, Sandberg bluegrass, threadleaf sedge and needle-and-thread. Dominant perennial forbs, in decreasing order of cover/frequency, were weedy milkvetch, ballhead sandwort, tufted fleabane, small-leaved pussytoes, silky lupine, and Hood's phlox. The dominant shrub was gray horsebrush. Trees were widely scattered in the grassland type. Sample sites represent the Idaho fescue/bluebunch wheatgrass habitat type. The bluebunch wheatgrass/Sandberg bluegrass habitat type is also present in minor amounts.

Annual production averaged 1,003 pounds/acre in 1982. Herbaceous species production was 984 pounds/acre, of which 55 percent was graminoid and 45 percent was forb. Shrubs averaged 19 pounds/acre or 2 percent of total production. Total shrub density in the grassland type averaged 1,158 plants/acre, with only gray horsebrush encountered on density transects.

#### b. Big Sagebrush/Grassland

The big sagebrush/grassland type averaged 91 percent cover. Important cover classes were perennial grasses (61 percent cover), perennial forbs (45 percent cover) and shrubs (34 percent cover). Dominant graminoids for two stands sampled were Idaho fescue (29 percent cover), big bluegrass (15 percent cover), bluebunch wheatgrass (11 percent cover) and western needlegrass (10 percent cover). Other important graminoids were basin wildrye and threadleaf sedge. Dominant perennial forbs, in decreasing order of cover/frequency, were silky lupine, sticky geranium, prairiesmoke, common dandelion, small-leaved pussytoes, common yarrow, and northwest cinquefoil. The dominant shrub was big sagebrush. Sample sites represent the big sagebrush/Idaho fescue habitat type.

Annual production averaged 1,405 pound/acre in 1982. Herbaceous species production was 789 pounds/acre, of which 61 percent was graminoid and 39 percent was forb. Shrubs averaged 616 pounds/acre or 44 percent of total annual production. Total shrub density in the big sagebrush/grassland type averaged 2,799 plants/acre, composed entirely of big sagebrush.

c. Low Sagebrush/Grassland

The low sagebrush/grassland type averaged 51 percent cover. Important cover classes were perennial grasses (29 percent cover), shrubs (26 percent cover) and perennial forbs (9 percent cover). Dominant graminoids for two stands sampled were Idaho fescue (11 percent cover) and bluebunch wheatgrass (10 percent cover). Other important grasses were prairie junegrass, needle-and-thread, Indian ricegrass and Sandberg bluegrass. Dominant perennial forbs, in decreasing order of cover/frequency, were broom snakeweed, tapertip hawksbeard, and rose pussytoes. The dominant shrub was low sagebrush, averaging 26 percent cover. Sample sites represent the low sagebrush/Idaho fescue and low sagebrush/bluebunch wheatgrass habitat types.

Annual production averaged 1,190 pounds/acre in 1982. Herbaceous species production was 345 pounds/acre, of which 77 percent was graminoid and 23 percent was forb. Shrubs averaged 845 pounds/acre or 71 percent of total annual production. Total shrub density in the low sagebrush/grassland type averaged 5,295 plants/acre, primarily low sagebrush (5,278).

d. Limber Pine/Grassland

The limber pine/grassland type averaged 59 percent cover, excluding tree overstory. Important cover classes were perennial grasses (38 percent cover) and perennial forbs (14 percent cover). Dominant graminoids for two stands sampled were Idaho fescue (28 percent cover) and bluebunch wheatgrass (9 percent cover). Other important graminoids were prairie junegrass and Ross sedge. Dominant perennial forbs, in decreasing order of cover/frequency, were nodding onion, twin arnica, common dandelion, and dotted gayfeather. Shrubs averaged less than one percent cover for the type. The tree overstory was dominated by limber pine and Rocky Mountain juniper, with scattered Douglas-fir. Sample sites represent the limber pine/Idaho fescue and probably the limber pine/bluebunch wheatgrass habitat types.

Annual understory production averaged 642 pounds/acre in 1982. Herbaceous species production was 632 pounds/acre, of which 65 percent was graminoid and 35 percent was forb. Shrubs averaged 11 pounds/acre or 2 percent of total production.

Total shrub density in the limber pine/grassland type averaged 979 plants per acre, composed of common snowberry (489), gray horsebrush (304) and big sagebrush (186).

e. Douglas-fir

The Douglas-fir type averaged 52 percent cover, excluding tree overstory. Important understory cover classes were annual forbs (29 percent cover), perennial forbs (20) and shrubs (10). Perennial grasses averaged only 1 percent cover in the stand sampled, due to closure f the tree canopy and historic livestock use. Annual forbs had invaded the site, particularly Fremont goosefoot, Richardson tansymustard, and blue-eyed mary. Dominant perennial forbs, in decreasing order of cover/frequency, were mountain sweetroot, Hook violet, common dandelion and stinging nettle. The dominant shrub was redshoot gooseberry, averaging 10 percent cover. The tree overstory was dominated by Douglas-fir, averaging about 70 percent cover in the stand sampled. Although significantly altered by livestock use, the sample site probably represents the Douglas-fir/ninebark habitat type.

Annual understory production averaged 288 pounds/acre in 1982. Herbaceous species production was 181 pounds/acre, of which 1 percent was graminoid and 99 percent was forb. Shrubs averaged 107 pounds/acre or 37 percent of total production. Total shrub density in the Douglas-fir type averaged 1,081 plants/acre, primarily redshoot goosebery (539) and mallow ninebark (270).

f. Quaking Aspen

The quaking aspen type averaged 80 percent cover, excluding tree overstory. Important cover classes were perennial forbs (52 percent cover), perennial grasses (37 percent cover) and shrubs (23 percent cover). Dominant graminoids for one stand sampled were Kentucky bluegrass (21 percent cover) and big bluegrass (17). Dominant perennial forbs, in decreasing order of cover/frequency, were common dandelion, mountain sweetroot, sticky geranium, Virginia strawberry, and bluntleaf sandwort. Dominant shrubs were mallow ninebark, common snowberry, chokecherry, and Wood's rose. The tree overstory was dominated by quaking aspen. Aspen stands in the study area are probably seral to the Douglas-fir/ninebark habitat type.

Annual understory production averaged 469 pounds/acre in 1982. Herbaceous species production was 426 pounds/acre, of which 32 percent was graminoid and 68 percent was forb. Shrubs averaged 43 pounds/acre or 9 percent of total annual production. Total shrub density in the quaking aspen type averaged 6,543 plants/acre, primarily common snowberry (2,496), mallow ninebark (1,518), Wood's rose (1,045) and chokecherry (978).

2. Grazing/Agricultural Uses

The permit area is not suited for cultivation; however, grazing is an historical land use. Range condition was qualitatively estimated as fair to excellent, depending on location in the permit area.

3. Noxious Weeds

No noxious weeds listed by the Montana County Weed Control Act (MCA 7-22-2101 through 2153) were recorded within the permit area during the 1982 inventory. Canada

thistle has since invaded some disturbed sites in the permit area and spotted knapweed is present along the access road corridor.

4. Species List/Rare Plants

A list of plant species identified 145 vascular plant taxa, including 18 perennial graminoids, 1 annual grass, 88 perennial forbs, 14 annual forbs, 20 shrubs and 4 trees. Cordilleran flora dominate the list, with some Great Basin and Great Plains influence. No rare plant taxa were recorded in the study area.

E. Wildlife

There are 68 mammals known or suspected to occur in the region encompassing the Yellowstone Mine. Some of these (e.g., mountain goat) would not be expected in the reconnaissance area because appropriate habitat is not available. Others are rare and have not been observed in the area in recent years. Of the 68 species, 24 (35 percent) were recorded during the 18 days of reconnaissance. This relatively high percentage per unit effort is indicative of the diversity of wildlife habitat in the reconnaissance area.

There are 295 species of birds that potentially occur in the region encompassing the reconnaissance area, however, many of these are water-related birds that would not be expected within the reconnaissance area, or others for which suitable habitat is not available. Therefore, 61 species were recorded during the reconnaissance, about 21 percent of the potential total.

Finally, eight reptiles and seven amphibians potentially occur in the region, but only one species, the prairie rattlesnake, was recorded during the reconnaissance.

Of 378 species of terrestrial vertebrates that potentially occur in the region, only five are listed as federally threatened or endangered. These include two mammals, the grizzly bear and gray wolf, and three birds; bald eagle, peregrine falcon, and whooping crane. The whooping crane does not normally migrate through western Montana, and suitable habitat is lacking in the reconnaissance area. An estimated 20 to 30 bald eagle winter along the Madison, Big Hole and Beaverhead Rivers, but none are known to nest in the project area. They were sighted within the reconnaissance area along the Madison Rive on seven occasions during three field periods.

Peregrine falcons may also winter along the river. No active eyries have been reported from the region, although cliffs along upper Ruby Creek in the Beaverhead National Forest, and along the Madison River about six miles south of the study area, could contain potential sites. There were no favorable eyrie sites in the intensive study area.

Gray wolves have been reported in the region, primarily far to the south. Wolves might be attracted to the area by large numbers of wintering big game, but relatively little is known of wolf densities in the region.

Grizzly bears are considered to be threatened in Montana. They may occasionally be present in the vicinity of the reconnaissance area, but the region probably does not contain an endemic population. Elk, moose, mule deer, whit-tailed dear, antelope, black bear, grizzly bear and mountain lion potentially occur in or near the reconnaissance area. Of these eight species, grizzly bears are probably not present. Moose may occasionally be present in the area, although suitable year-round habitat is not available. No white-tailed deer were observed during the reconnaissance. Bighorn sheep may have been present in the area in the past, but historical populations were decimated by introduction of domestic livestock, particularly sheep. No bighorns are presently found near the project area, although potential habitat is available. Potential habitat is not present in the project area for mountain goats.

Black bear scats, diggings and hair were found in limber pine and Douglas-fir habitats in November 1981, but no evidence was observed within the intensive study area. Mountain lion tracks were observed in snow in upper Johnny Gulch, about three-quarters mile west of the mine area, in May 1982. Mule deer were abundant in this area during the preceding winter, and mountain lion(s) may be present in rugged, rocky areas west and south of the mine. Mine employees have seen lions in the vicinity on rare occasions.

Elk were not observed in the reconnaissance area in March and November 1981 or August 1982. However, elk tracks were observed during every field period during the reconnaissance, and it is likely that a few elk are present in the area year-round. Much of the extensive reconnaissance area is considered to be crucial elk winter range, including the ridge in sections 33 and 34, T8S, R1W. Typical elk winter range in the region is dominated by Douglas-fir and sagebrush habitats on south and west slopes and ridge tops. Hunting pressure may discourage the migration of elk and mule deer into the area until later in the winter.

Mule deer were seen during each field period, and appear to be more abundant than elk in the reconnaissance area. They were distributed over a greater area and used a wider variety of habitats than elk. The most important habitats year-round appeared to be big sagebrush, bunchgrass and limber pine. The number of sightings by season was similar to elk, in that sightings were fewest in November during hunting season, and were greatest in winter and spring. Average group size was lowest in August at 1.6 and 3.0 in November and 3.3 in May, 7.0 in March and 9.2 in February. Thus, group size followed the expected trend of increasing during autumn to a winter peak, then declining through spring to a summer low. Mule deer seemed to be less wary of human disturbance than elk, and were commonly sighted in the mine area. The entire reconnaissance area is considered mule deer winter range.

Antelope were present year-round on the gently rolling bench between the Madison River and the intensive ground study area. Average group sizes of antelope fluctuated by season, similar to elk and mule deer.

Coyotes were common throughout the reconnaissance area and were sighted six times during the study period. Coyote numbers and the high mule deer population in the area at the time of reconnaissance (combined with the nature of the terrain in much of the study area)

suggest that while coyotes may kill mule deer during winter, such mortality had not prevented a deer population increase.

### 1. Small Mammals

Small mammal snap trapping in November 1981 was quite unproductive, and only deer mice were caught. May 1982 results were also quite poor, with only the low sagebrush habitat producing more than five percent success. Again, only deer mice were caught in all habitats except one; a single vole (probably meadow vole) was trapped in perennial grass habitat.

A live trap grid spanning four major habitats was set in May 1982 and trapped for four consecutive nights; eight species were caught, however, all but three species were caught only once, with no recaptures of marked individuals. The red-backed vole and red squirrel were caught only in Douglas-fir habitat, the montana vole only in perennial grassland, and the western jumping mouse and long-tailed vole were captured only in big sagebrush. Deer mice were caught in all habitats, while Columbian ground squirrel, three; and one individual each of red-backed vole, long-tailed vole, montana vole, western jumping mouse and red squirrel.

### 2. Raptors

Eight raptor species were observed in the reconnaissance area during the study period; only three of these species were believed to have nested within the reconnaissance area. Two possible red-tailed hawk breeding territories were located, based on defensive behavior of paired adults. No nests or fledglings were found, however. American kestrel adults were seen perched in Douglas-fir snags west and south of the intensive study area in May 1982. Young birds were seen with adults in the same areas in August, suggesting successful reproduction. Hooting great horned owls were heard in Johnny Gulch in February, and an immature owl was seen in this area in May.

Of the other five species, bald eagles, golden eagles and prairie falcons are the most sensitive to human activity. The other two species, Swainson's hawk and marsh hawk, were probably migrants. Nesting was not observed, and preferred nesting habitat was not available in the intensive study area.

### 3. Game Birds

Upland game birds potentially occurring in the reconnaissance area are blue grouse, ruffed grouse, ring-necked pheasant and gray partridge. The western third of the reconnaissance area may be considered blue grouse spring-autumn habitat (primarily Douglas-fir and aspen types). Ruffed grouse are primarily found in aspen and deciduous streambank habitats, which are limited in the study area. Ring-necked pheasants and gray partridge may be reaching their distributional limits near the project area. Although sage grouse are an important game bird in southwestern Montana, they are not found along the Madison River. There is little waterfowl habitat in the reconnaissance area.

Of 61 species of birds recorded during the reconnaissance, about 33 were thought to nest within the reconnaissance area. Other species may have nested within the area, but no form of nesting behavior was observed.

The only drainage in the intensive study area that contained flowing water at any time during the five field periods was upper Johnny Gulch. The impoundment near the west edge of section 9 contained a macroinvertebrate community. Qualitative inspection at several points along Ruby Creek suggested a good diversity of benthic macroinvertebrates, including Plecoptera, Trichptera, Ephemeroptera and Diptera. The Madison River, at the east edge of the extensive study area, is a "blue-ribbon" trout fishery.

F. Air Quality

Air quality measurements conducted during mine operations through 1984 have shown that the area encompassing the Yellowstone Mine meets Montana and Federal ambient air quality standards. The maximum annual geometric and arithmetic means of total suspended particulates (TSP) were 15 and 25 micrograms per cubic meter ($ug/m^3$), respectively. The maximum 24-hour TSP concentration recorded was 95 $ug/m^3$. In addition to the Yellowstone Mine, local sources of air pollutants in the Yellowstone Mine area include other mining activities, logging operations, wood smoke from wildfires and slash burning, and vehicle traffic on unpaved roads. More recent monitoring conducted by the Montana Talc Company in the immediate area has shown occasional elevated particulate levels. The Air Quality Bureau is currently reviewing the information to determine the need for additional emission controls at either or both of the mining operations.

Emissions of gaseous pollutants derived from diesel engines and blasting compounds are very minor and have little impact on area air quality.

Particulate matter emissions derive primarily from drilling, blasting, loading, hauling and ore handling. These are minimized by sound engineering practices. Particulate emissions are primarily large particles which fall out quickly and are not transported a significant distance downwind. There is little emission of PM-10 size particulates from combustion or crushing operations. Particulate emissions from haul roads are controlled with speed restrictions and watering. Blasting patterns are kept to a minimum with no overshooting. The impact of mine air pollutant emissions on surrounding air quality and visibility is usually minimal. The nearest Federal Prevention of Significant Deterioration (PSD) regulations Class I area (Yellowstone National Park) is approximately 25 miles south (upwind) of the mine. Emissions from the mine are not anticipated to have any impact on the Class I area. An application for an alteration to the existing air quality permit for the Yellowstone Mine will be submitted to the DHES.

Johnny Gulch is located in the Gravelly Range west of the Madison River, approximately 20 miles south of Ennis, Montana. Area climate may be described as modified continental, since temperature fluctuations are moderated by Pacific Ocean air masses, drainage of cooler mountain air into the valley, and the shielding effect of mountains.

Temperatures in the area are moderate: maximum temperatures during the summer are generally under 90 degrees Fahrenheit (F) and seldom exceed 100 degrees F. During summer nights, temperatures usually cool into the low 50's (F). Winter temperature extremes are usually near 10 degrees F at night and warm up to about 32 degrees F at mid-day.

Precipitation varies widely int he area due to the influence of the mountains. Precipitation totals from the nearest National Weather Service (NWS) reporting stations do not reflect actual mine area precipitation.

Wind speed and direction measurements taken on site during 1982 indicated an average wind speed of 10.9 miles per hour (mph). The resultant wind was from 205.2 degrees at 5.1 mph. Wind persistence was 47 percent, and predominant wind direction was from the south-southwest.

G. Land Use and Transportation

Historic land use of the permit area was ranching and mining. The Ruby Mine was a gold operation that was never financially successful. Talc mining has been conducted in the area since 1949. Current land use in the area is primarily talc mining and ranching.

Land and mineral ownership within the permit area is shown in Figure 4.

H. Aesthetics

1. Visual

The permit area is located on a terrace at the foothills of the Gravelly Range. It is approximately 12 miles southwest of the community of Cameron and 22 miles south of Ennis, Montana.

The most visually dominant evidence of mining activity in the area includes waste dumps and pits. The North Waste Dump is visible from Highway 287 and from the county road accessing the mine. Other mining features are not conspicuous from public access areas, except within about one mile of the mine site.

2. Noise

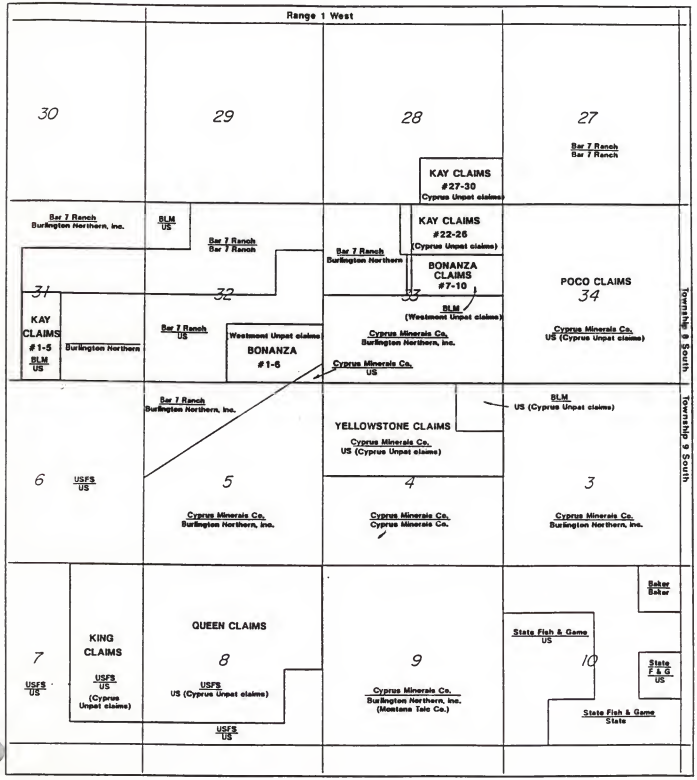
Ambient (pre-mining) noise levels were primarily those of natural origin. Exceptions included vehicle noise during hunting or grazing season.

At full production, the operation is expected to be audible over ambient background noise (wind, etc.) from a distance of about one-half mile. Since there are not permanently habitated structures within this radius, no significant noise impacts are anticipated.

I. Socioeconomic Environment

CIMC initiated operations at the Yellowstone Mine in 1950, when no detailed socioeconomic baseline investigation was required. No increase in personnel is anticipated to accommodate the Yellowstone Mine revised operating plan.

Figure 4. Surface and Mineral Control in the Vicinity of The Cyprus Yellowstone Talc Mine.



## J. Cultural Resources

Seven sites and eight minimal activity loci (MAL's) were recorded on the project area. Of three historic sites, one was a homestead, one a gold mine and mill, and the third a portion of road grade used to access the high Madison River terraces.

### 1. Historical Sites

The Lewis Clark Homestead (24MA289), patented in 1920, was a marginal ranching operation. The only structure remaining in 1982 was a log structure then used as a storage shed by the mining operation. Historic trash scatters (L8 and Trashed site) are possibly related to this homestead.

The Ruby Mine site (24MA285) consists of the remains of a hoist house, an adit entrance, a loading ramp and bin, and a shaft headframe. The mill complex, outside the project area in the Ruby Creek canyon, consists of mill remains and frame cabins. The mine was a marginal operation since extraction of gold from iron ore was infeasible at the time of operation (1936-1937).

Historic access to the high terrace and foothills of the Gravelly Range was by the Baker Grade Road (24MA291) constructed circa 1879. It was initially used primarily for ranch access and later for access to the Ruby Mine and mill.

### 2. Prehistoric Sites

Prehistoric sites documented in the study area reflect a variety of activities, but none provided information on use of the talc resource. Two subsurface sites provided only limited information; one is a surficial lithic scatter and one is a line of rock cairns assumed to be associated with game (bison?) procurement. Prehistoric minimal activity loci were single, isolated flakes of local material. None of the MAL's could be placed chronologically, since no temporally diagnostic items were found.

The Icy Pond site (24MA286) and the Trashed site (24MA287) are small, subsurface sites in Johnny Gulch. Both contained flakes of basalt, chert and ignimbrite. The Trashed site also contained historic trash and bone fragments which could not be separated stratigraphically from prehistoric material. This site is at the junction of two roads, has been affected by stock pond construction and road maintenance, and is severely disrupted. The Icy Pond site has received no apparent impact. No temporal information was obtained from either site.

The Baker Drive Lines (24MA290) consist of nineteen small rock cairns which parallel the edge of one of the higher Madison River terraces. They extend approximately 130 meters, and apparently were used to channel game animals into the adjacent draw. No temporal information was obtained at the site.

The Pink Orange site (24MA288) is a lithic scatter encompassing 40 meters squared. It contains fourteen items including a spokeshave, a core, two biface fragments and pieces of

debitage. One biface fragment (and possible the core) exhibited high lustre, suggesting that local chert was heated prior to reduction and tool manufacture.

Interpretation of prehistoric use of the area requires recognition of local crypto-crystalline materials: jaspers and chalcedonies occur in the dolomite which contains talc. Although no prehistoric quarry or extraction area has been identified locally, such a site may exist in the area.

### 3. Management Recommendations

Of eight sites recorded, three were recommended as eligible for nomination to the National Register of Historic places (NRHP): Baker Drive Lines (24MA290), Ruby Mine (24MA285), and the Icy Pond site (24MA286).

The Baker Drive Lines are eligible because these structures are a relatively unusual phenomenon in the area. Game procurement strategies are of considerable research importance, and use of such cairn lines provides insight into prehistoric use of local topography.

Although it is significant to local history of the Madison Valley, the Ruby Mine (24MA285) was not eligible for NRHP listing in 1982 because it was less than fifty years old. Mine structures have been fully recorded, photographed and documented. Although it was recommended that the mine structures be avoided if possible, they have no architectural or engineering significance, and no additional inventory was recommended. In the mill area, the frame house and mill are deteriorating, but will not be affected by proposed talc mining activity.

The Icy Pond site is not located on the Yellowstone Talc Mine permit area. Other cultural sites on the project area were not recommended as eligible to the NRHP, and no additional work was recommended.

## CHAPTER III - THE COMPANY'S PROPOSED ACTION

### A. Introduction

The following is a detailed review of the CIMC's present operating plan. The Yellowstone Mine is an open pit talc operation. Waste rock is deposited on site, with ore processed on site to upgrade the talc for shipment to Three Forks to Cyprus's mill. The pit sorter facilities area on the mine site presently includes a mechanical sorting plant, a hand sorting plant and a small shop. A second hand sorting facility is located east of the mine. An office/shop complex is located about one mile northeast of the mine area, including headquarters, maintenance area and fuel storage tanks. Access to the property from U.S. Highway 287 (Figure 2) is jointly maintained by CIMC and Montana Talc Company for the county.

### B. Location

The Yellowstone Mine is situated in the east foothills of the Gravelly Range, Madison County Montana (Figure 1). Mining occurs in Section 4 and part of Section 9, T9S, R1W and an office/shop complex and sedimentation ponds are located in the southeast corner of Section 34, T8S, R1W and the northeast corner of Section 3, T9S, R1W (Figure 2). The property consists of patented and unpatented claims as depicted in Figure 4 (surface and mineral control are both shown).

The permit boundary encompasses about 1,223 acres, of which approximately 540 would be disturbed (Figure 2). The mine permit boundary would be marked with fenceposts and signed "Mine Permit Boundary".

CIMC has asked for this amendment to obtain permission to construct a small particle sorter, product storage, and a flotation mill in the facilities area by 1991. Tailings from the flotation mill would be stored in an impoundment. The changes to the present operating plan are discussed in the following sections.

### C. Life-of-Operations Plan

#### 1. Eight-Year Mine Plan

The Yellowstone Mine currently has an eight-year mine plan within a total resource base of about 30 years. As the South Main Pit nears completion in early 1989, mining efforts would focus on the South 40 Pit, the North 40 Pit, and the North Main Pit. The tonnage of mined material would remain essentially constant, however produced talc tonnage would increase through implementation of new recovery techniques: small particle sorting and flotation. The planned production scenario has 300,000 tons per year (TPY) of talc produced from about 4,060,000 TPY of mining and 30,000 TPY of reprocessing. About 3,780,000 TPY of waste would be produced as follows:

| Origin | TPY |
|---|---|
| Pit waste and bone | 3,180,000 |
| Mechanical sorter waste | 350,000 |
| Shed sorter waste | 20,000 |
| Small particle sorter waste | 80,000 |
| Flotation tailings | 150,000 |
| TOTAL | 2,780,000 |

Five principal waste sites have a total design capacity of 32,800,000 tons at a tonnage factor of approximately 1.5 tons per loose cubic yard:

| Disposal Site (Exhibit II-1) | Eight-Year Capacity in Tons |
|---|---|
| North Waste Dump | 6,000,000 |
| South Dump - Waste | 15,000,000 (to 6,175-foot elevation) |
| South Dump - Bone Stockpile 2 | 4,500,000 (to 6,225-foot elevation) |
| Future Pit Sorter Dump[1] | 6,000,000 |
| Tailings Impoundment | 1,300,000 |
| TOTAL | 32,800,000 |

[1] The future Pit Sorter Dump would not span Johnny Gulch until the designed tailings impoundment reaches capacity.

From 1989 to 1994, ore would be recovered from mining in the South 40 Pit and North 40 pit; waste stripping would be performed in the North Main Pit. From 1994 to 1996, ore would be recovered from the North Main Pit and waste stripping would be conducted in the South 40 Pit. In 1996 and 1997, ore would be recovered from the South 40 Pit and North 40 Pit. The eight-year plan is designed to provide construction of a flotation mill with sufficient capacity to deposit tailings for the eight-year term. It is expected that the mill would continue to operate beyond this term, requiring additional tailings storage.

2. Future Plans

Mining and processing would continue beyond this eight-year plan. Although future operations cannot be confidently predicted at this time, certain longer-term activities of pit backfilling and tailings deposition would affect ultimate reclamation. A new pit sorter dump was permitted as part of previous amendments approved in 1986 and 1988. The new flotation mill and tailings disposal area precludes construction of this pit sorter dump. As a pit sorter dump would be necessary during long-term operations, it is likely that, upon

completion of tailings deposition in Johnny Gulch, pit sorter material would be placed over the tailings to the proximity of the mill

CIMC is not prepared at this time to provide additional elaboration on activities beyond the eight-year plan. Prior to implementation of activities not addressed by this plan, CIMC would contact the regulatory agencies and request approval for any modifications affecting operations or reclamation. Amendments would be submitted as necessary to reflect such changes and additional environmental analyses would be prepared.

D. Mine Plan

1. Pit Design

Mining volumes and methods would continue in accordance with presently-permitted activities. The deposit is mined by open pit methods conducted in 25-foot lifts with 25 or 50-foot benches. Once exposed, the talc can be free-dug or is shot lightly (popped) as needed. Waste rock is drilled on a 15 x 15-foot grid and blasted. Waste and talc are loaded with four-yard hydraulic shovels and 7.5-yard loaders into 35-ton and 50-ton haul trucks for transport out of the pit. Waste rock is hauled to dumps. High-grade ore and low-grade ore are processed on-site to separate waste from talc. Processed talc is then shipped to Three Forks, with sorter waste hauled to a dump. Flotation waste would be deposited in the proposed tailing impoundment.

Since talc ore is not continuous throughout the pit areas, some waste rock is separated in-pit and hauled directly to waste dumps. Mining equipment capacity allows mining of 13,000 tons of waste rock and bone per day, and 4,000 tons of ore per day. Year-long operation of the mine would result in an average waste/bone production of 3,180,000 tons per year (TPY) and an average ore production of 880,000 TPY.

Mining is conducted 5 days per week, three 8-hour shifts per day for 12 months of the year. Weekend shifts are implemented as required. Areal coverage of the South Main Pit would be 20.1 acres at projected completion (1989). The South Main Pit, nearing its current economic limit, is not presently planned to be backfilled except to provide access to the North Main Pit. Projected capacity is 8.4 million tons, or 5.6 million loose cubic yards (lcy).

The South 40 Pit would be the principal ore source from 1989 - 1994 and 1996-1997, designed at 15 million tons, or 10 million lcy of material. Areal coverage would be approximately 35.2 acres. The North 40 Pit, a substantially smaller pit (designed at 8.2 acres and 1.6 million tons or 1.1 million lcy), is intended to be a supplemental ore source to the South 40 Pit during those time periods.

The North Main Pit would be the principal ore source from 1994 - 1996, designed to remove 7.8 million tons or 5.2 million lcy of material with areal coverage of 38.6 acres.

2. Waste Rock Disposal

Waste from the pit and from mechanical ore-sorting operations is deposited in the waste dump areas. The waste rock consists primarily of dolomite, with minor amounts of talc, chlorite, calcite, quartz and feldspar. Since all are extremely stable and not easily weathered, no leaching or decomposition is anticipated. The 125.4-acre waste dump sites would have combined capacity of about 14 million loose cubic yards (21 million tons) of waste rock material for the eight-year plan.

Areal coverage of the North Waste Dump is projected at 38.7 acres. The North Waste Dump is presently on-site, but would be expanded for this eight-year plan, allowing additional capacity of 6 million tons or 4 million lcy.

Plan-view area of the presently permitted South Waste Dump would be approximately 86.7 acres, with a design capacity of 15 million tons or 10 million LCY. Bone stockpile 2, to be constructed atop the South Waste Dump at 6,175 - 6,225-foot elevation, has a design capacity of 4.5 million tons or 3.0 million lcy.

A planned Pit Sorter Dump has an additional capacity of 6 million tons or 4 million lcy. Construction of this future pit sorter dump (beyond the eight-year plan) would post-date completion of tailings deposition in the proposed impoundment.

Waste rock material would consist of angular (shot or crushed) rock ranging in size from boulders to sand fines. The fines are a small percentage of the waste resulting in a stable, quite permeable waste dump. With few fines available in the waste, no buildup of phreatic surface is anticipated within waste dumps. During operation, dumps would be constructed to maintain drainage from the top to avoid ponding. Waste dump sites would be stripped of all soil and subsoil suitable for reclamation. Collection ditches and settling ponds would collect runoff from the mine site, and remove sediment prior to allowing runoff water to flow from the permit area.

3. Blasting Plan

Waste rock is drilled on a 15 x 15-foot grid and blasted (generally 50-100 holes per pattern). Once exposed, the talc can usually be free-dug but would be shot lightly (popped) as needed. The primary blasting agent used is a mixture of ammonium nitrate and fuel oil (ANFO), using a bulk system. Blast firing procedures would be an integral part of daily operating routine at the mine.

E. Ore Processing Plan

After blasting, material is loaded and hauled or conveyed to various locations according to grade:

<u>Waste material</u> is predominantly dolomite with minor qualities of talc, chlorite, calcite, quartz and feldspar. Pit waste (approximately 65 percent of mined material) is hauled directly to waste dumps.

Bone material has been stored on-site since 1969 in Bone Stockpile 1. Technological advancements would soon allow the profitable segregation of talc from bone.

Mechanical sorter feed material contains sufficient talc to be mechanically sorted from host dolomite.

Shed feed is the richest talc ore, containing 10 percent or less waste material, and is sorted manually.

A flow sheet depicting processing methods and volumes by grade is given in Figure 5. The facilities area presently includes a mechanical sorting facility, an infrequently used hand sorting facility, and a small shop. It is planned to add a small particle sorter (SPS), and a flotation mill to the facilities area. Ore would then be processed with both "dry" and flotation methods. Crude ore stockpiles 1 and 2 would contain up to 30,000 and 20,000 tons, respectively.

1. Mechanical and Manual Sorting

Ore processing involves crushing and sorting to separate talc from waste rock. This is essentially a "dry" process, with only about one gpm water required for mechanical sorting. No chemicals or additives are required in this process.

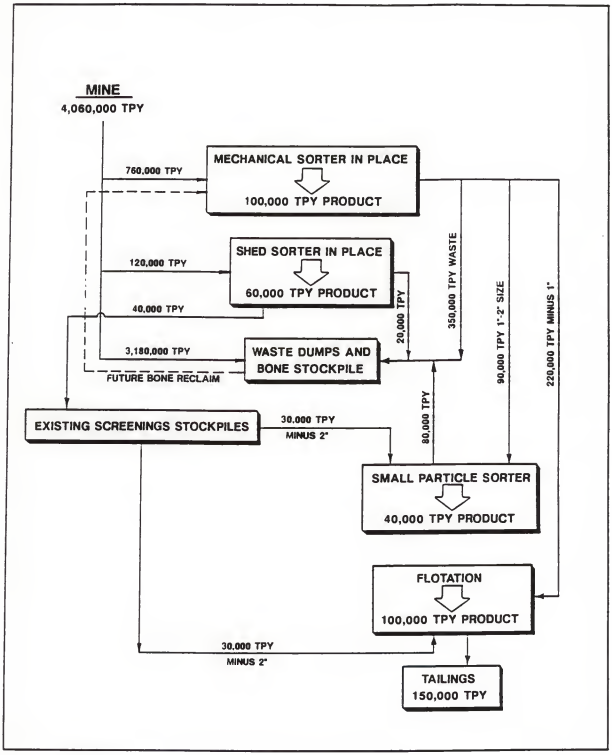
Waste and bone material would be hauled to the South Dump or North Dump. Bone material would be stored in a specific location on the South Dump in Bone Stockpile 2 to be processed in the future. Bone dumps would be processed on site with a mobile sorter within 3 to 5 years, with waste deposited in waste dumps or in pits determined to have no economic potential.

Mechanical-sorter feed is hauled to the mechanical sorter where it is sized to 2- to 12-inch fragments by a grizzly and screen. The oversize is crushed by a jaw crusher. The crude is then fed onto a conveyor where talc is hand-picked or mechanically segregated from waste. The +1-inch portion of the undersize would be sent to the small particle sorter which would mechanically separate talc from waste. The minus 1-inch fraction of the undersize would be conveyed to the flotation plant.

Shed feed is sent to the shed-sorting facility where it is sized to 1/2-inch to 12-inch fragments. The sized shed material is then fed onto a conveyor where waste rock is separated from talc by hand.

Ore produced at the mine is trucked to the Three Forks Mill and processed there for customer shipments. All hauling form the mine is independently contracted.

Figure 5. Yellowstone Mine Process Flow Sheet



2. Flotation (To Be Implemented In 1991)

a. Process Description

i. Mill Feed Storage and Feeder

Feed is received as 100 percent, minus 1-inch size from the Yellowstone sizing screen. Material is delivered by conveyor belt to a closed bin near the mill building. The bin room (40 feet diameter x 80 feet tall) has a nominal capacity of 2,000 tons (approximately 2 days' feed).

ii. Classification

Classification is by means of a screen, and feed is by vertical sump pump from the classifier feed/ball mill discharge sump. The slurry is dumped onto a two-deck wet screen with spray bars. The top deck is a 10M scalper, the lower deck is 30 mesh. Screen oversize reports by gravity to ball mill feed. Screen undersize reports by gravity to a nominal 3000-gallon, agitated conditioner tank, where dilution makeup and reagents are added. The conditioner tank reports by gravity to the rougher flotation section.

iii. Grinding

Grinding is in a conventional, closed-circuit 9 x 10-foot, 450 hp ball mill. Feed is from the classifier screen oversize at -1/2-inch. Recirculating load is 200 percent. Ball mill discharge reports to the classifier feed/ball mill discharge sump. The recirculation of fines assures adequate pulp viscosity for pumping raw feed oversize. Rejection of raw feed -30m undersize reduced overgrinding of the float feed.

iv. Flotation

Derrick screen undersize, after about 3 minutes conditioning with reagents as methyl isobutyl carbinol (MIBC) at one-half pound per ton feed, reports by gravity to a rougher section. The rougher section has twenty, 300-cubic-foot column flotation cells in two sets of ten. Rougher tails report to a sala pump for delivery to the tailing thickener. Rougher concentrate reports to a sala pump for transfer to the first cleaner.

The first cleaner consists of six, 300-cubic-foot cells downstream of the second cleaner via a drop box, which receives rougher concentrate and second cleaner tails. First cleaner tails return by gravity to the classifier feed/ball mill discharge sump. First cleaner concentrates report to a sala pump for transfer to the second cleaner head.

The second cleaner also consists of six, 300-cubic-foot cells. Second cleaner tails report by gravity to the first cleaner feed. Second cleaner concentrate reports by sala pump to the 30-foot concentrate thickener.

Flotation cells are equipped for reagent additions at each drop box. Concentrate launderers and sala pump sumps are equipped with spray bars to control froth.

### v. Tailings

Plant tails report to a 60-foot cone-bottom tank thickener. Thickener overflow reports to a reclaim water sump by gravity, and thickener underflow is pumped to the tailing impoundment. Tailing reclaim water and any interceptor well (below tailing dam) are collected and returned to the plant makeup water feed tank.

### vi. Concentrate Thickener

Second cleaner concentrate reports to a 100-foot thickener. Thickener overflow reports to the reclaim water sump, while thickener underflow reports to a filter makeup feed sump and is pumped to the concentrate filter.

### vii. Concentrate Filtration

Drum filtration is assumed for this design, and would require two, 20-foot units of 12-foot diameter. The alternative is pressure filtration with integral wash and air blowdown. Drum filtration would yield a 25 percent moisture cake. Pressure filtration would yield an 8 to 12 percent moisture cake. Final design would be governed by optimization of capital, operating costs of the filter alternatives, and fuel costs of drying.

The drum filters produce a filter cake which is delivered by screw feeder to a flash dryer. Filtrate is delivered to the reclaim water sump.

### viii. Concentrate Bleach Circuit

Certain areas of the Yellowstone mine contain iron-stained talc which does not meet brightness requirements for certain industrial applications. Flotation concentrate from these ores must be bleached with zinc sulfite in a special bleach treatment circuit prior to filtration and flash drying.

Talc concentrate from the flotation concentrate thickener would be pumped to a series of three 14-foot diameter x 16-foot treatment tanks. About 8 pounds of zinc dust and 3 pounds of sulfur dioxide gas would be added to the first bleach treatment tank and agitated for 1 hour. Pulp would flow from the first tank to tanks two and three where additional sulfur dioxide gas would be added in each tank.

The bleached concentrate is then filtered on two 12-foot diameter by 20-foot drum filters to remove the bleach liquor from the talc concentrate. A wash solution containing hydrochloric acid is then used to rinse the talc filter cake. The talc concentrate is then repulped with a solution of caustic soda to neutralize pH, and again filtered on two 12-foot diameter by 20-foot drum filters before flash drying.

The leach liquor from the first two drum filters is neutralized with lime and discharged with the flotation tailings. High carbonate content of the flotation tailings would prevent the iron from oxidizing and creating an acid drainage. All iron would remain as solid ferric hydroxide in the tailing impoundment.

The bleach treatment tanks would be covered and sealed. The tanks would be constructed from acid-proof materials, and the treatment area would be curbed to contain any potential process spill. All bleach treatment chemicals are commonly used in the mining industry, and the hazards and storage and handling requirements area well understood. Treatment chemicals are listed below:

1. Zinc dust (Zn)
2. Sulfur Dioxide ($SO_2$)
3. Hydrochloric acid (HCl)
4. Caustic Soda (NaOH)
5. Lime ($Ca(OH)_2$)

All employees would be trained in safe handling procedures for all chemicals, and would be required to wear personal protective equipment when handling them. A self-contained breathing apparatus would be maintained near the area, and employees would be trained in its use. The reagent storage and mixing area would be designed to maintain safe distance between chemicals, and would be curbed to prevent accidental release.

### ix. Drying

Filter cake is delivered to a flash dryer and moisture is reduced to less than 1 percent. Assumed design has the dried product delivered to product silos by pneumatic conveying. An alternative would be a walled-off section of the building serving as a bin, with live bottom feeders in the floor and product delivered by screw-feed conveying for vertical lift and radial stacking.

### x. Plant Water Makeup

Recycled water is pumped to a 300,000-gallon tank from the reclaim sump and the tailing water reclaim. Additional makeup water from wells is provided to compensate deficit losses; the plant is zero discharge. A portion of (fresh) well water makeup is stored for culinary and sanitary use (10,000 gallons), and fire water use (50,000 gallons). Suitable electric/diesel powered fire water pumps are provided.

### xi. Buildings

The plant is expected to be totally housed in an 86 x 168-foot (14,448-square foot) pre-engineered steel building. The building would be suitably insulated. Primary building heating is to be supplied from dryer off-gas in an air-to-air heat exchanger, with standby gas, propane, and/or oil/fired heating provided.

Any control rooms, offices, etc. required would be pre-fabricated, free-standing units.

b. Tailings Disposal

i. Disposal Methods

CIMC proposes to construct a tailings disposal impoundment in the Johnny Gulch drainage within their existing permit area (Figure 6). The expanded South Waste Dump would be utilized as the tailings dam. The South Dump expansion extends dump materials across the intermittent Johnny Gulch drainage. Figure 6 shows the location of the waste rock dump across the Ruby Mine Gulch and Johnny Gulch drainages. A rock drain containing 2-inch to 12-inch pit sorter reject material is located at the bottom of the Johnny Gulch drainage and below the waste rock dump. The rock drain has been designed to handle 150 percent of the 100-year flood flow rates through the Johnny Gulch drainage area. Design and stability of the South Dump and associated rock drain have been determined previously and approved by DSL.

Dump slopes would be set at the angle of repose during tailings pond operations. When designed capacity is achieved in the impoundment, dump slopes would be regraded to a slope of 2h:1v for reclamation purposes. The waste rock dump should be drained at all times by the rock drain. The angle of repose for waste material is approximately 34 to 38 degrees (1.25h:1v). Since stability of the waste rock dump has been previously approved, only the potential impact to stability due to addition of the tailings pond is addressed here.

The tailings would be impounded upstream of a waste rock dump that, at final configuration, would fill Johnny Gulch for approximately 2,000 feet downstream of the tailings deposit. In like manner, the tailings would be contained on their upstream end by a waste rock fill approximately 250 feet across at the base and 140 feet high, against which the tailings rise to only 70 feet. These rock fills, acting as gravity dams, are more than adequate to provide stable impounding structures. Reclamation of the tailings impoundment involves capping the tailings with waste rock, resoiling, and revegetating the area. The rock drain would be protected from infiltration of tailing fines by a geomembrane placed above the rock drain itself and between the tailings and the waste dump.

A geomembrane liner is proposed between the tailings and the rock drain, between the tailings and the upstream slope of the South Waste Dump, and between the tailings and the downstream slope of the road fill forming the upstream containment of the facility (Figures 6, 7). The primary purpose of the liner is to prevent infiltration of tailings fines into the rock drain which would compromise the drain's flow capacity. The secondary purpose of the liner is to prevent direct infiltration of pond water into the rock drain from the waste rock embankment, road fill, or the bottom of the impoundment.

A geomembrane liner is not proposed for the remaining side slopes of the impoundment. The natural foundation materials, clayey colluvium derived from the volcanic bedrock immediately upstream of the site, would greatly restrict the amount of seepage loss as well as prevent migration of tailings fines to the rock drain.

Figure 6. Contour Map Showing Cyprus Tailings Pond Location

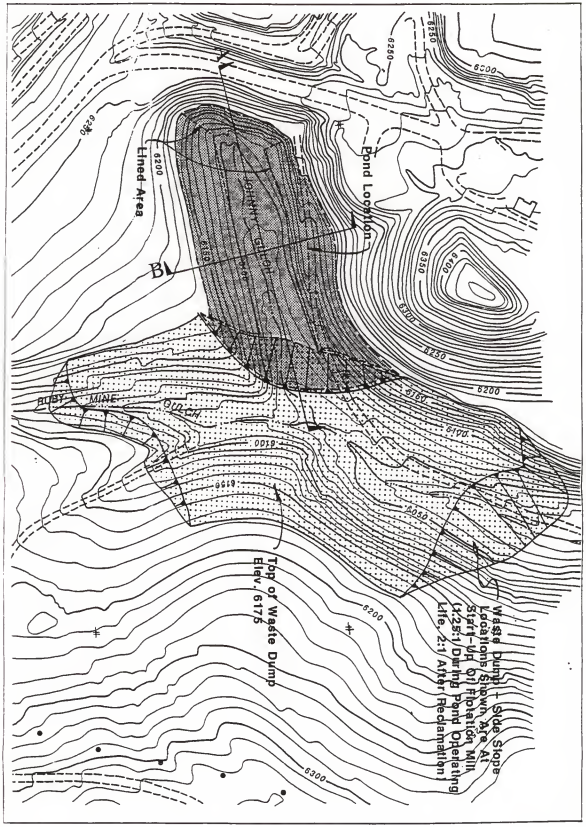
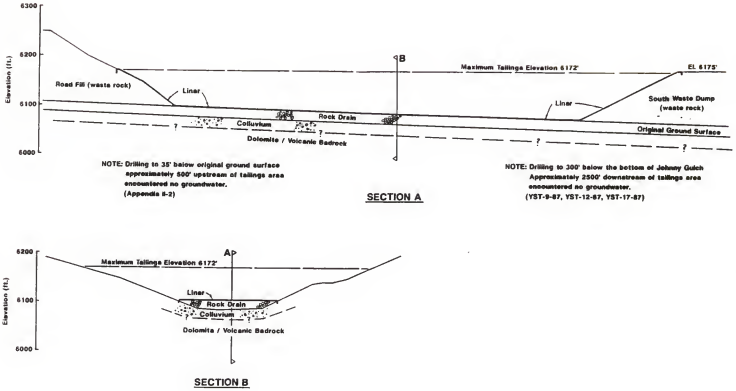


Figure 7. Cross Sections of Cyprus Tailings Facility



The geomembranes proposed for the liner system are 40-mil, ultra-violet-stabilized, exposable polyvinyl chloride (PVC) for the pond and 45-mil, reinforced CSPE (Hypalon) for the embankment. These materials are compatible and can be joined to one another. A non-woven geotextile would be placed beneath the geomembranes to protect them from puncture by the subgrade. It is presently proposed to use an 8-ounce/sq. yd. (approximately 90 mil) non-woven geotextile beneath the PVC in the pond bottom, and a 16-ounce/sq. yd. (approximately 180 mil) non-woven geotextile between the CSPE and the face of the embankments. The 8-ounce/sq. yd. material replaced the 12-inch graded soil filter in the previous proposal. It is expected that large rocks would be removed from the toe of the waste dump embankment and the road fill, and that both slopes would be faced with a 2.5-inch minus screen material from the mechanical sorter in order to further protect integrity of the geomembrane.

Outer edges of the geomembranes and geotextiles would be secured in backfilled trenches. The geotextile on the embankment faces may require pinning and stitching to adequately secure it to the slope. It may be necessary to doze a road at mid-height on the embankment faces to allow an intermediate securement trench to support the weight of the geomembrane and afford easier installation. These possibilities would be determined during final design.

The tailing impoundment would be reclaimed by capping with waste rock, soil replacement, and revegetation. At closure the tailings would be allowed to dry to a point at which they would support the placement of a waste rock cap. It is estimated this would be within 6 months of cessation of tailings placement. At this time waste rock from either the ongoing operation or the adjacent South Waste Dump would be placed to provide a smooth transition to the grade of the downstream waste dump. It is estimated the average thickness of the cap would be 3 feet. The area of the cap would be 12.6 acres resulting in a volume of approximately 61,000 placed yards of fill to cap the tailings. Soil replacement and revegetation would be according to criteria given in the Reclamation Plan.

### 3. Expected Life of Impoundment

The waste rock dump is expected to be advanced over the rock drain as a single-lift dump with an ultimate crest elevation of 6,175 feet. Using a freeboard of 3 feet, the maximum elevation of tailings disposal within the pond would be 6,172 feet.

The total surface area available for tailings disposal to an elevation of 6,172 feet is approximately 12.63 acres. The total volume available for tailings disposal to an elevation of 6,172 feet is approximately 26,057,000 cubic feet. Volumes were computed by the average-end-area method, utilizing planimetered areas.

Assuming an average weight for the tailings of 100 pounds per cubic foot, total capacity of the tailings pond is approximately 1,300,000 tons of tailings. Since annual production of tailings is estimated at 150,000 tons per year, the tailings pond would allow over eight years of available storage to 6,172-foot elevation.

4. Tailing Water

Seepage from the tailings area to the rock drain/colluvium unit is estimated using an effective free water pond area of 100,000 ft.$^2$, an effective average permeability of 2 x $10^{-5}$ ft/min, and a gradient of 1.0. This results in a calculated seepage flow rate of approximately 15 gpm in the rock drain/colluvium unit beneath the tailing facility.

Quality of seepage is assumed to be equivalent to the mill water in the tailings slurry. Mill water would originate from the make-up well system located in Ruby Creek south of the project site. The talc beneficiation process proposed is a combination of flotation to separate talc from the gangue minerals (primarily dolomite and quartz), with subsequent bleaching of a portion of the recovered talc to remove iron and raise the talc brightness.

The flotation process uses water from the Ruby Creek well system with the addition of methyl isobutyl carbinol (MIBC) as a frothing agent. The flotation circuit operates at the natural pH of the system. The Ruby Creek water has a pH of 7.8 to 8.0. The ore feed is primarily a mixture of dolomite, talc and quartz and the dolomite would serve to buffer the system, maintaining a pH of approximately 8.0 throughout the flotation and tailings water system. Therefore, no dissolved heavy metals are expected to occur in the flotation circuit.

The MIBC, an alcohol widely used throughout the mining industry as a frother, serves to enhance the creation of bubbles in the flotation cells and promote talc flotation. The MIBC is added to the mill feed at a rate of 0.06 lbs/ton of ore. The MIBC, much lighter than water (specific gravity = 0.8) and only slightly soluble in water, will primarily travel with the talc product stream to the bleaching and/or drying circuits rather than with the tailings stream. The mill designers estimate that five percent of the MIBC may travel with the tailings stream and that none of the MIBC could survive the bleaching circuit (Ray Hyyppa, Johnson-Hyyppa, personal communication). Assuming no other losses due to volatilization or oxidation, the MIBC concentration in the tailings water would be approximately 2 ppm. This level of MIBC is well below the toxicity limits published in the Material Safety Data Sheet, and is less than one percent of the LC50 level of 460 ppm for fathead minnows provided by Union Carbide (Union Carbide, personal communication). Based on this information, MIBC is not considered to threaten beneficial use of the water resource in the area.

The bleaching circuit uses sulfur dioxide gas and zinc dust at a hydrochloric acid-maintained pH of 2.5 to remove iron from the talc and raise its brightness. The raw bleach liquor is expected to have very high concentrations of dissolved zinc, chloride, and sulfate along with the iron and other minor impurities removed from the talc. Because the raw bleach liquor is totally unsuitable for discharge to the tailings facility, it would be treated with lime to adjust the pH to 8.0 and precipitate the dissolved metals.

The chemistry of the neutralized bleach liquor has been analyzed for primary parameters introduced during the bleaching process, indicating the following concentration ranges: 0.21-0.22 ppm zinc, 290-309 ppm chloride, 90-185 ppm sulfate. The treated bleach liquor is diluted approximately 44 percent in the tailings thickener, giving a resultant tailings effluent of approximately 0.12 ppm zinc, 162-173 ppm chloride, and 50-104 ppm sulfate.

In the absence of an identified receiving water, and since drilling to approximately 300 feet beneath Johnny Gulch has failed to encounter a water table and historical experience indicates no surface water is discharged from the site, CIMC believes that seepage from the tailings facility would not impact water resources of the area.

Assuming the tailings water is suitable for discharge to the proposed tailings facility, the operating condition (with continual input of tailings water from the mill) should represent the most critical phase of the project with regard to water quality. High buffering capacity of the finely divided dolomite tails, gradation of the tails, and low precipitation in the area combined with the reclamation plan should preclude development of a poor quality leachate following reclamation of the tailings facility.

F. Transportation Plan

1. Access Road

Traffic associated with the operation consists primarily of employees traveling to and from work, talc haulage to the loadout facility at Three Forks, and supply vehicles servicing the mine (Figure 2).

Employees living in the Ennis area travel by company bus via U.S. Highway 287. Access from U.S. 287 is by Madison County Road to the east edge of Section 35, thence on Forest Service Road 324 to the mine site. A portion of the latter segment was reconstructed in 1986 to avoid the mining operation. Approximately 24 commuter trips per day are generated over this route by Yellowstone Mine Employees and vendors, excluding contract hauling.

The haul route from the mine site to U.S. Highway 287 follows the commuter route described above. The haul route follows U.S. 287 approximately 68 miles to the mill at Three Forks. Talc is hauled with 33-ton highway trucks which are primarily a dump truck with two pup trailers. Projected production of 300,000 tons per year of talc would require an average of 758 trips per month. Since talc hauling is conducted 5 to 7 days per week depending on weather and production scheduling, about 25 trips per day would be required for highway trucks, or 2 trips per day per truck.

Supply vehicles include fuel delivery of diesel and gas once a week, delivery of explosives once a month, truck removal of waste oil every three months, and occasional vendors, agency personnel, and visitors. Total mine-related traffic would generate about 50 trips per day on the access route.

Maintenance of the access road is currently conducted jointly (50/50) by CIMC and the adjacent Montana Talc Company operation. Upon cessation of mining activities, maintenance would revert to Madison County and the U.S. Forest Service.

Access to the well water supply on Ruby Creek (Figure 2) crosses surface controlled by Montana Department of Fish, Wildlife and Parks (Figure 4). Access on that property is

restricted during the period December 1 to May 15, however, the agency has indicated that use of snowmobiles would be appropriate during this period to monitor/service wells.

2. Haulage Roads

Internal roads connect pits with waste dumps and the facilities site. Haul roads are 55 feet wide, built above the natural ground or pit bottom utilizing pit waste material at a grade of 6 to 10 percent. Berms on each side of haul roads are at least one-half the tire height of largest haul vehicles at the mine. Road construction evolves within the pits and dump areas as mining progresses. Grade width and drainage of these roads is similar to that of haul roads. CIMC maintains haul roads with graders, and provides dust control with water on in-pit haul roads and a magnesium chloride stabilizer applied annually on the access road to Highway 287. CIMC controls traffic on in-pit haul roads; private vehicles are not allowed access without authorization.

3. Snow Removal

Snow removal and disposal are required during periods of winter operation. Snow removal would be performed in a manner to preserve and protect roads, bridges and other facilities, prevent erosion damage and preserve water quality. Snow would be removed from the entire road surface including turnouts. All debris, snow and ice removed from the access road surface would be deposited away from the Madison River. During snow removal, banks would not be undercut or surface material removed from the roadway. Snow berms would not be left on the road surface. Berms left on the shoulder of the road would be removed and/or drainage holes opened at the end of winter operations. Drainage holes would be spaced as necessary to obtain satisfactory surface drainage and would avoid runoff on erodible slopes. Ditches and culverts would be kept functional. Snow would be remove promptly to insure safe, efficient transportation. In areas susceptible to heavy drifting of snow on the roadway, drift fences or snow berms may be used to facilitate maintenance of traffic. CIMC would contain ore and waste rock in a manner so that snow disposal would not introduce sediment into the Madison River. Routine snow plowing is expected to have no impact on the area water quality.

G. Infrastructure

1. Equipment

CIMC requires equipment to mine, haul waste, and reclaim disturbed areas. Following is a list of equipment currently used at the Yellowstone Mine:

| Type | Number |
|---|---|
| Haul Truck | |
| 16-ton | 1 |
| 35-ton | 8 |
| 50-ton | 4 |
| 245 Shovel (4.5-yard) | 4 |

| Type | Number |
|---|---|
| Loader | |
| 950 (3.0-yard) | 1 |
| 980 (5.5-yard) | 1 |
| 988 (7.5-yard) | 2 |
| Backhoe | 1 |
| Bobcat | 1 |
| Dozer | |
| D-8 | 1 |
| D-9 | 1 |
| Grader | 1 |
| Support Equipment | |
| Lube truck | 1 |
| Fuel truck | 1 |
| Water truck | 2 |
| Service truck | 1 |
| Service truck | 1 |
| Powder truck | 1 |
| Crane | 1 |
| Fork lift | 1 |
| Drills | 2 |
| Light Plants | 5 |
| Pickups | 12 |
| Mini-bus | 2 |
| Ambulance | 1 |

Equipment is repaired and maintained at the office-shop complex.

2. Personnel

The Yellowstone Mine and mill employ 165 personnel. Mining operates three 8-hour shifts, 5 days per week and one shift on the weekend. Pit/mechanical sorting operates three 8-hour shifts, 7 days per week, and shed sorting operates three shifts, 5 days per week. When the revised processing system is operational in 1991, pit sorting would be entirely replaced by mechanical sorting which would operate three shifts, 5 days per week. A flotation plant and small particle sorter would each operate 7 days per week. No increase in personnel would be required; current employees would be retrained to operate the new facilities. The trucking contractor employs an additional 16 people. CIMC does not have to file a plan with the Hard Rock Mining Impact Board.

In addition to operating and maintenance personnel, CIMC has a Yellowstone Mine office with support personnel including management, engineering, geological, accounting and other administrative personnel.

3. Water Consumption and Source

Water requirements for mine operation are currently 55,000 gallons per day in summer and 2,000 gallons per day in winter. Water is used primarily for dust control in spraying of haul roads, the mine and waste dump areas, and transfer points. A storage tank with approximately 20,000-gallon capacity is located in the facilities area to provide storage to meet surge demands and is available for fire emergencies. A 750,000-gallon water storage impoundment is located in Johnny Gulch to collect creek water for seasonal use; CIMC has filed with the Montana DNRC for an appropriation for this water.

CIMC plans to sue well water to meet additional needs for flotation processing. Other potential water supplies would be investigated and reviewed with appropriate agencies prior to implementation. Water requirements for flotation processing would be approximately 576,000 gallons per day, with 50 percent as make-up water.

Potable well water is provided in appropriate locations in the facilities area and office/shop complex. Estimated potable water consumption is about 0.5 to 1 gallon per employee per day.

4. Sewage and Solid Waste Disposal

Toilets provided at the pit sorter facilities area are equipped with a 2000-gallon and a 1000-gallon holding tank. Tanks are pumped weekly and sewage is disposed of by a licensed vendor. The vendor is responsible for obtaining permits for disposal of sewage in accordance with local and state rules. Toilets at the shed sorter/training room and office/shop complex are equipped with drain fields.

Solid waste is disposed of by burial in trenches in the waste rock dump, as approved by the county sanitarian.

5. Power Consumption and Source

a. Electricity

Electricity is provided by a 12,000-volt powerline to the mine site, supplied by Montana Power Company; total demand presently averages approximately 420 Kw. Future demand would increase to approximately 2,000 Kw. Power requirements by use are:

| Site | Kw | |
|---|---|---|
| Office/shop complex | 40 | |
| Ore processing: sorters and crusher | 310 | |
| Hot start line (cold weather only) | 70 | |
| Flotation mill (1991) | 1580 | |
| TOTAL | 420 | (present) |
| | 2000 | (future) |

b. Fuel Oil

Fuel oil is used at the mine site to heat the shop building and fuel mobile equipment, and gasoline is used by light vehicles. Fuel oil and gasoline are delivered by tanker truck to the mine site and unloaded into fuel storage tanks. At least one week's supply of fuel oil is maintained in reserve. Fuel storage and dispensing facilities have been designed to control and contain spills. Storage facilities (17,000 gallons for diesel and 5,000 gallons for gasoline) are located in the office/shop complex and facilities area. Fuel is stored in steel tankage meeting all code requirements; tankage is enclosed by lined containment berms that hold 1.5 times the volume of tankage or volume of the largest tank. Storage capacity provides for approximately 8 operating days (one week plus some cushion to allow for inclement weather, extra shifts, etc.).

c. Liquified Propane Gas

Liquified propane gas (LP gas) is used to heat the mechanical sorter, the training building and the office. Tanks (500 to 1000-gallon) are serviced by a vendor.

6. Vehicle Maintenance

A vehicle maintenance area is located in the office/shop complex. Procedures for vehicle maintenance include salvage of all waste oil, fuels, grease, etc. in containers for recycling or disposal. Procedures for cleanup of minor, inadvertent spills would include use of absorbent materials and removal of contaminated soil for selective burial in the waste rock dump. Spills in excess of 25 gallons would be treated as a major spill and handled as described in the spill contingency plan.

7. Communications

Phone service is available at the office, shop, shed sorter and mechanical sorter. Radios are used in mine-related vehicles to coordinate safety, shipments and mine activities. Volunteer ambulance unit members carry portable radios for emergency use.

8. Fire Protection

Fire protection is keyed toward prevention, especially through employee education. Loading of flammable vegetation near the mine and sorter is minimal, reducing fire hazard there. All bulk petroleum products are surrounded by containment berms (for spillage as well as fire protection, with fire extinguishers available nearby. Extinguishers are located throughout the office/shop complex and plant facility, and on each piece of equipment. The water truck used to control road dust is equipped with a pump and fire hose to provide mobile fire protection. A 20,000-gallon steel water storage tank available for fire emergency is located in the facilities area. Fire protection and prevention training programs are incorporated into the company's mine safety training plans. Mufflers are utilized on trucks and heavy equipment. The fire protection and prevention program is in accordance with local and MSHA rules and regulations.

## H. Environmental/Public Protection Plan

### 1. Drainage and Sediment Control

The drainage and sediment control plan is designed to protect area water quality from sediment impacts related to the mining operation. All runoff water in the mine area is presently collected in operating pits and allowed to percolate into the porous rock formations, or the runoff flows down Johnny Gulch to two sediment ponds near the office/shop complex.

Since mine waste dumps, bone piles and sorter piles are permeable, composed of coarse rock, and quite resistent to erosion, most water percolates through the material rather than flowing over or around it. The site configuration contains all runoff waters within the Johnny Gulch drainage. Since operational experience in the area has indicated that erosion can be controlled using existing sediment ponds (below the South Waste Dump), no additional ponds or diversions are planned. Construction of the South Waste Dump in Johnny Gulch would not require diversions or ponds since it is an expansion of the existing plan which includes a rock drain designed to handle 150 percent of the 100-year event. Runoff would continue to flow to sediment ponds northeast of the South Waste Dump.

Construction of the North 40 pit would intercept water from a relatively large drainage area. Since inclusion of this water in the pit is not desirable, a diversion would be constructed to divert upgrade runoff water to the south to a sump that connects with an existing ditch constructed by Montana Talc Company on their property (Figure 2). The diversion of all watershed flow from a 100-year event is neither necessary or practical for the Yellowstone operation, since it would require a large ditch and resultant disturbance, as well as modifications to existing diversion structures on the Montana Talc property. The purpose of the Yellowstone Mien diversion is for convenience and safety of operation in the North 40 and South 40 pits, and is not necessary for environmental safeguards. It was determined that diversion of average flows (hence selection of the 2-year event) would be sufficient. Runoff from larger events would be allowed to drain into the pit, pond in low areas provided in normal operation, and seep into the ground.

The discharge rate was estimated using "Urban Hydrology for Small Water sheds", USDA Technical Release 55, Second Edition (June 1986). Flows approximating the 2-year event (1.75 cfs) would be diverted to the south toward the Montana Talc property. Flow in excess of the 2-year event would be diverted into the pit utilizing a dam in the ditch and a spillway to allow a desired flow (1.75 cfs) over the dam. Any greater flow would divert into the spillway and into the pit. The ditch grade is designed for 1 percent, utilizing a "V" section. The ditch would connect at this gradient with the existing ditch on Montana Talc Property.

### 2. Activities in Non-Disturbed Areas

Both disturbed and non-disturbed areas are included within the mine permit boundary. Mining and ore processing activities would be confined to disturbed areas identified in this permit application. Activities that may occur in non-disturbed areas include surveying and

environmental monitoring. No temporary or permanent disturbances are anticipated in any areas other than those designated as disturbed areas in the permit application.

3. Protection of Off-Site Flora and Fauna

All mining and ore processing activities would occur within proposed permit boundaries. The mining and ore processing plan requires no use of lands peripheral to permitted areas. Mining and ore processing activities are designed to have minimal impact on air and water resources, and are anticipated to have minimal impact on off-site flora and fauna.

4. Protection of Historical and Archaeological Values

As described in Section I. N. Cultural Resources, eight cultural sites were recorded in the extensive study area, of which three were recommended as eligible for nomination to the National Register of Historic Places. Only the Icy Pond site was expected to be impacted by proposed mine activities. The Icy Pond site contains an intact subsurface component with potential to yield temporal information, information on use of the talc resource, and data on summer camping activity. It is presently located within the Montana Talc Company permit area.

5. Prevention of Wind Erosion

To prevent air quality degradation due to wind erosion, all roads would be watered as needed; chemical palliatives are used to suppress dust annually on the access road from Highway 287. A detailed plan for mitigation of air quality impacts is included in the air quality permit application for this operation.

Wind-blown tailings are not expected due to impoundment water levels and moisture content of tailings. If a beach area becomes exposed, tailings would be stabilized by sprinkling.

Final reclamation would be implemented upon completion of mining, including recontouring of selected areas, topsoiling and revegetation. These procedures would prevent post-mining wind erosion.

6. Noise

Primary sources of noise a bulldozers, shovels, loaders and trucks in the mine, as well as mechanical processing equipment in the facilities area. Noise levels are commensurate with those expected of a moderately sized hard rock mining operation. The project area is several miles from permanent human habitation.

7. Public Nuisances

CIMC strives to alleviate public nuisance during mining and with final reclamation. Operational and reclamation procedures approved by DSL would be followed. All laws and

regulations would be carefully followed to avoid air and water pollution. In the event that a public nuisance is developed, CIMC would evaluate the situation and develop a program to abate or eliminate the nuisance.

Public access to shop facilities and the active project area is controlled by the use of locked gates to prevent unauthorized entry. Pit access would be controlled by berms at the conclusion of operations. Public safety is maintained on public portions of the access route by conspicuously placed informational signs, the use of locked gates where appropriate and radio communications in haul trucks.

CIMC has developed a blasting plan that meets the approval of DSL regulations for public information and safety. When equipment is not being used, security is provided to prevent unauthorized use.

8. Traffic Plan

CIMC is committed to reducing traffic-related impacts to public roads, through maintenance and bus transportation provided by the company. Depending on scheduling, talc trucks average 25 trips per day from the mine to Three Forks; visits by agencies or others are expected to create one trip per day. Water and chemical dust palliatives are utilized to suppress dust on unpaved roads.

Maintenance and safety features on the access road include:

- Whenever operations on the existing road identify ares which must be altered for safe travel, plans for correction would be submitted to the agencies for approval prior to road work;
- Grading as needed when rutting occurs. The roadbed is bladed to maintain an outslope no greater than 1.5 percent.
- Traffic signs are posted at appropriate junctions.

9. Spill Contingency Plan

CIMC's Spill Contingency Plan identifies responsibilities within the company in the event of a spill, and provides for dissemination of emergency information and agency notification. The primary objective is to provide CIMC, suppliers and contractors with information necessary to properly respond to a diesel, dry material, or flotation reagent spill event.

Types of spills addressed by this plan include: 1) dry material in transportation-related spills (e.g., waste rock or ore), 2) fuel oil spills either from tanker transports or from diesel storage tankage in the facility area, and 3) spills associated with flotation processing.

CIMC has identified the person to direct overall emergency response activities. The individual's name, work number, and off-duty phone number are prominently displayed at

key information points. This individual maintains reporting procedures in compliance with state and federal regulations. Emergency phone numbers are prominently displayed on communication equipment at the mine sit and office/shop complex.

The emergency response coordinator ensures that all CIMC employees, suppliers, and contractors involved with the Yellowstone Mine area notified of spill prevention, material handling, and cleanup procedures.

CIMC's representative would maintain records of all significant spill events. Spills involving more than 25 gallons of petroleum products would be reported to the Water Quality Bureau. Significant dry material spills, spills which endanger human health or safety, and spills which compromise access or cause significant disturbance to public roads would be reported to Madison County. Any spill involving disturbance or potential degradation of surface water or groundwater would be reported to the Water Quality Bureau.

Emergency response priorities in the event of a spill include:

- Taking necessary steps to safeguard health and safety;
- Immediate notification of proper authorities;
- Determining the source and attempting to stop the flow or minimize the spill;
- Initiate containment procedures; and
- Clean up and restoration.

10. Operational Water Monitoring Plan

CIMC proposes to establish the following operational water quality monitoring stations, and sampling and reporting at the given intervals:

| Station | Location | Sample Interval |
|---|---|---|
| TA-100 | Tailing Thickener Outfall | Monthly/MIBC Quarterly |
| JG-500 | Johnny Gulch Rock Drain | Observe Monthly/Sample Quarterly |
| JG-300 | Johnny Gulch Colluvium Well | Observe Monthly/Sample Quarterly |
| JG-100 | Office/Shop Well | Quarterly |

Note: "Monthly/MIBC Quarterly" indicates the station would be sampled monthly for pH, nutrients, common ions and trace metals and quarterly for MIBC.

Note: "Observe Monthly/Sample Quarterly" indicates the station would be observed for water on a monthly basis and sampled the first time water is observed in each quarter. If no water is observed in a quarter the station would be reported as dry for the quarter.

The Johnny Gulch Rock Drain (JG-500) and Colluvium Well (JG-300) are to be located at the downstream toe of the South Waste Dump. The Rock Drain station would sample water existing the rock drain at the ground surface. The Colluvium Well would be a monitoring well installed to bedrock to sample water in the colluvial material in Johnny

Gulch. The Office/Shop Well (JG-100) is the existing potable water well located at the Office/Shop complex at the extreme east limit of the permit boundary.

All samples would be analyzed for dissolved constituents using the following parameter list and detection limits.

| Parameter | Detection Limit |
|---|---|
| pH | ± 0.1 units |
| Nitrate + Nitrate as N | 0.05 ppm |
| MIBC (TA-100 only) | 5 ppm |
| Common Ions: | |
| Chloride | 1 ppm |
| Sulfate | 1 ppm |
| Trace Metals: | |
| Zinc | 0.02 ppm |

Note: MIBC would be sampled and analyzed quarterly from Station TA-100 only.

I. Reclamation Plan

1. Introduction

This reclamation plan addresses CIMC's proposed eight-year operating plan (1989-1996) and includes four pits, six waste rock, sorter and bone dumps, a tailings impoundment, on-site facilities, an office/shop complex, roads and associated disturbances. The operating plan assumes mining about 4 million tons per year over the eight-year period producing about 300,000 tons of talc per year. Total reserves are not fully defined; however, estimated reserves may allow mining for about 30 years. Mining past 1996 would primarily affect pit area and depth and waste material (rock, bone and tailings) deposition. Sufficient area is available within the permit boundary and adjacent lands of CIMC surface ownership to allow for additional waste disposal by increasing the horizontal or vertical dimensions of the sites and by the possibility of pit backfilling.

Reclamation planning for the Yellowstone Mine has been designed to satisfy state and federal requirement governing mineral development in Montana. Specific statutes and rules include the Montana Metal Mine Reclamation Act (Title 82, Chapter 4, Part 3, MCA) and adopted rules implementing the Act and the Montana Environmental Policy Act (MEPA) and DSL guidelines implementing MEPA. CIMC has committed to revising reclamation plans on all disturbances since the mine opened in 1951.

a. Objectives

The short-term objectives of reclamation are to 1) stabilize disturbed areas through erosion and sedimentation control, 2) control noxious weeds, and 3) prevent air and water pollution. This would be achieved by a combination of operational practices, sediment and erosion control systems, interim revegetation and noxious weed control. Air quality controls

are detailed in a separate application submitted to the Air Quality Bureau. Monitoring during the operating phase would ensure that these objectives are met.

The long-term objective of reclamation is to establish a post-mining environment that is compatible with existing and proposed land uses of the area.

The following sections discuss procedures to accomplish these objectives. Modifications to this plan may be made by CIMC, based on advancements in reclamation technology, operational changes or results of actual reclamation. Changes would only be made after consultation with and approval by appropriate regulatory agencies.

b. Post-Mining Land Use

The area is currently private land owned by CIMC (Figure 4). The primary land use is mining. Additional uses of the area include wildlife habitat and watershed.

The goal of long-term reclamation is to provide land use comparable to that on adjacent lands. Specific objectives include:

- reestablishment of biological potential suitable for supporting vegetative cover appropriate to the area allowing resumption of livestock grazing;
- permanent protection for air, surface water and groundwater resources;
- protection of public health and safety by minimizing potential hazards;
- maintenance of access around the project area;
- restoration of wildlife habitat;
- design of a stable land configuration compatible with the watershed; and
- reestablishment of an aesthetic environment allowing for visual quality and recreational opportunity.

2. Topography and Grading

a. Waste Rock Dumps

In order to reduce erosion potential and enhance visual quality and revegetation, dump sideslopes would be reduced by grading with a tracked dozer after waste rock deposition has been completed. Reduction would be conducted by grading waste rock down the slope. The most extensive grading would be required on the face of the North Dump. At design capacity, approximately 308,700 bcy (bank cubic yards) would be graded to reduce the slope from angle of repose (about 1.25h:1v) to approximately 2h:1v. Dump benches would be created during construction to facilitate grading.

The South Dump is a valley fill and would not require extensive grading except on the downstream face. A portion of the upstream face would be covered by tailings. That portion of the upstream face not covered by tailings (Ruby Mine tributary) would be graded to 2h:1v. The downstream face of the South Dump would also be graded to 2h:1v. In order to reduce surface runoff and the effect of wind on revegetation of the flat surface of the South Dump, small undulations would be created by deep ripping or grading. Approximately 137,300 bcy in the South Dump would be graded at design capacity to achieve post-operation topography.

Terraces are not planned on the dump sideslopes as slope reduction should negate their necessity. If it becomes apparent that additional measures are needed to reduce erosion on the sideslopes, terraces or other alternatives would be considered in consultation with DSL.

An inactive bone stockpile (1) is currently present in the northwest corner of the permit area. A second active bone stockpile (2) is proposed to be situated on the South Dump. The longevity of the bone stockpiles is related to the economics of processing this low-grade material. It is estimated that it would be feasible to begin processing bone stockpile 1 within 3 to 5 years. Material from bone stockpile 1 would be processed on-site with waste placed in the north waste rock dump or the main pits. As bone stockpile 2 is processed, waste would be placed in the South Dump. The bone stockpile sites would revert to pre-stockpile topography after processing. As a worst case, if it is not feasible to process the bone stockpiles, they would remain in place. Sideslopes would be graded to 2h:1v by grading downslope. Estimated worst-case grading volume to reduce the bone stockpile slopes is 28,900 bcy for bone stockpile 1 and 11,600 bcy for bone stockpile 2.

b. Pit Sorter Dumps

As with the bone stockpiles, pit sorter dump 1 contains low-grade ore that may become feasible to process. In this case, post-mining topography would be similar to pre-dump topography. If economics do not allow processing, the dump would be left in place with sideslopes graded to 2h:1v. Worst-case grading volume for pit sorter dump 1 is approximately 15,800 bcy. Pit sorter dump 2 is non-commercial. The face would be graded to 2h:1v with an estimated grading volume of 36,600 bcy.

c. Tailings Impoundment

The tailing impoundment would be reclaimed by capping with waste rock, soil replacement, and revegetation. At closure the tailings would be allowed to dry to a point at which they would support the placement of a waste rock cap. It is estimated this would be within 6 months of cessation of tailings placement. At this time waste rock from either the ongoing operation or the adjacent South Waste Rock Dump would be placed to provide a smooth transition to the grade of the downstream waste dump. It is estimated the average thickness of the cap would be 3 feet. The area of the cap would be 12.6 acres resulting in a volume of approximately 61,000 placed yards of fill to cap the tailings.

d. Pits

Overall slope of pit walls would be approximately 46 degrees (1h:1v) with 25 or 50-foot wide benches (flat) and 65 degree (approximately 0.5h:1v) walls. In order to reduce the hazard to humans, livestock and wildlife, berms would be constructed around final pit crests. As discussed in the operating plan (Life of Operations), insufficient information is available to commit to pit backfilling; however, backfilling would be practiced where ore grade and mine economics allow pit condemnation.

e. Facilities Area and Office/Shop Complex

Minor grading would be necessary to blend cuts and fills with adjacent topography. Crude ore stockpiles, buildings, the shop, and scale would be removed and processed and the sites ripped prior to resoiling.

A buried pipeline would provide water from the Ruby Gulch wells to the flotation mill. Above Ruby Gulch the pipeline traverses a steep, rocky slope where conventional excavation burial is not possible. Upslope from the fill, diversion berms would be constructed to minimize flow over the fill. Berms would be 1.5 to 2 feet high. It is anticipated that the pipeline would be constructed and reclaimed during fall 1989 or spring 1990. An alternative powerline may be chosen over the buried electrical service to provide power to the well site; surface disturbance would be reclaimed immediately after powerline construction.

The highwall of the gravel pit would be reduced to 2h:1v unless Madison County or USFS assumes responsibility of the pit for road maintenance. Exploration trenches and trails in the office/shop area were reclaimed during 1989. The soil storage area would revert to pre-mine contours upon final reclamation.

All compacted sites would be ripped prior to soil redistribution.

f. Roads

Internal operations roads (haul roads and dump ramps) would be reclaimed, as would be the abandoned segment of the old public road from the Johnny Ridge Road to the mine. The Johnny Ridge Road would be retained as constructed as a public road. The mine access road would also be retained for access to the property.

The mine access road from the Johnny Ridge Road through the property would be reduced in width by ripping, resoiling and seeding the excess width (about 35 feet). Berms, where present, would be graded over the fill slopes prior to reclamation.

g. Sediment Control Structures

Three sediment ponds would be left for livestock and wildlife uses after mining. The diversion ditch and associated sump would be backfilled to approximately original topography after mining ceases in the North 40 Pit. Estimated backfill volume is 250 bcy. The two

sediment ponds would be breached unless the adjacent landowner or grazing lessee desires and DSL concurs that the ponds be left.

3. Soil Handling

a. Soil Salvage

Soil has been salvaged from previous disturbances within the CIMC permit area except for soil storage areas. Soil materials would continue to be salvaged from remaining areas to be disturbed, with the exception of slopes exceeding 50 percent, soils having a coarse fragment content in excess of 50 percent and soil storage areas. Proposed soil salvage acreages and volumes (1989-1996) are listed in Table 1. Soil would be direct hauled whenever possible, or otherwise stored in stockpiles. Soil stockpile volumes (previously salvaged soils and soils to be salvaged) are presented in Table 2.

Table 1. Proposed Soil Salvage Volumes (1989-1996), Yellowstone Mine

| Proposed Disturbance | Area Disturbed (acres) | Estimated Salvageable Soil Volume (bcy) | Soil Stockpile |
|---|---|---|---|
| Waste Disposal Sites South dump portion | 2 | 5,380 | 4 |
| North 40 Pit | 3 | 6 450 | 6 |
| Flotation mill site | 5.6 | 25,800 | 7 |
| Diversion Ditch | 1.2 | 250 | stored in place |

Where possible, non-merchantable trees, shrubs, and slash would be dozer-piled into windrows (using a brush blade to minimize soil accumulation) and burned. All requirements of the Montana Slash Disposal Law would be observed. Soil materials would be salvaged using dozers, front-end loaders and trucks. Salvage material would include organic debris such as residual slash, stumps and ashes from burned slash piles. Every effort would be made to minimize compaction during soil handling operations. Soil would be handled only when it exhibits good tilth and is moderately dry. Soil would not be disturbed again until it is redistributed.

Table 2. Soil Stockpile Volumes (in Bank Cubic Yards)

| Stockpile | Previously Salvaged | To be Salvaged | Total |
|---|---|---|---|
| No. 1 [1] | 4,294 | 0 | 4,394 |
| No. 1A [1] | 10,542 | 0 | 10,542 |
| No. 2 [1] | 8,771 | 0 | 8,771 |
| No. 3 [3] | 99,459*** | 0 | 99,459*** |
| No. 4 [1] | 33,679 | 5,380 | 39,059 |
| No. 5 [1] | 8,131 | 0 | 8,131 |
| No. 6 [2] | 0 | 6,450 | 6,450 |
| No. 7 [2] | 0 | 25,800 | 25,800 |
| No. 8 [1] | 800 | 0 | 800 |
| Total | 144,776 | 37,630 | 182,406 |

[1] Existing Stockpile
[2] Proposed Stockpile
[3] Approximately 21,000 bcy of this stockpile will be retained for use by Montana Talc under an existing agreement

Soil salvage depths would vary from 12 to 50 inches, with an average depth of 30 inches. The majority of soils have been salvaged, as shown in Table 2.

Soils would not be salvaged or respread on trails established within the permit area. These trails would follow natural ground and would not require cuts and fills. The trails would be ripped, if necessary, for final revegetation.

b. Soil Storage and Protection

Stockpile sizes would vary throughout the live of the mine as incremental salvage is implemented. The estimated life of the stockpiles is life of mine. Soil storage areas are located to avoid surface runoff. An additional soil protection measure is reduced sideslopes. They would be or have been constructed with 2.5h:1v sideslopes. The primary method of stockpile protection, however, will be through revegetation. The stockpile surface would be loosened if necessary to provide a proper seedbed. The interim seed mixture would be broadcast seeded during the first appropriate season following stockpiling and as necessary when soils are added or removed. Mulch would be applied to the piles as necessary.

c. Soil Redistribution and Fertilization

Soils would be redistributed on all disturbed areas except pits and soil stockpile sites. Soil redistribution depths would be variable, reflecting salvage from specific areas, stockpile location and volume and haul distance. It is not anticipated that soil would be hauled long distances to achieve a uniform redistribution depth. A minimum redistribution depth of 3.6 inches would be applied to resoiled disturbances. Soils calculations do not include redistribution over potentially backfilled pits.

Since a large portion of the area disturbed to date was affected prior to reclamation requirements, minimal soil materials are available from pre-law disturbances. In order to increase the effectiveness of available soil materials, CIMC would evaluate the following approaches:

1. salvage any additional subsoil materials available prior to further disturbance;
2. assess enhanced, site-specific reclamation techniques which may include additional erosion and sedimentation control measures, application of organic material, surface manipulation, and/or modifications to species mixes to accommodate shallow soil redistribution;
3. test physical and chemical characteristics of rhyolitic waste material to determine suitability for use as redistributed subsoil. This assessment would include an analysis of economic and operational feasibility of utilizing the rhyolitic waste.

CIMC would coordinate with DSL in this evaluation to maximize reclamation success consistent with requirements of the MMRA.

Soil would be redistributed on slopes up to 2h:1v using tracked dozers blading and back-blading down and up the slope. Soil redistribution would create small trenches perpendicular to the slope (dozer tracking) which would catch seed and reduce erosion.

Prior to soil redistribution or revegetation, compacted areas (especially waste dump tops, roads, soil storage areas and the facilities and office/shop areas) would be ripped to relieve compaction. This would also eliminate potential slippage at layer contacts and promote root penetration. Soil materials would be applied in lifts as thick as possible to decrease compaction. Organic debris which has been salvaged and stored in soil stockpiles would be respread along with soil. This would create microsites and reduce soil movement by creating a rough seedbed surface.

Application rates for fertilizer would be based on soil tests, taking into consideration future management practices and provision of a nutrient reservoir in the seedbed. Fertilizer rates would be formulated to achieve soil macronutrient levels of 15 ppm nitrogen, 30 ppm phosphorus and >50 ppm potassium. Highly soluble phosphorus fertilizer materials would be evenly broadcast prior to seeding. The soil surface would then be disced and/or harrowed along the contour to break up large clods, prepare an appropriate seedbed and incorporate phosphorus fertilizer into the soil. Fertilizer and mulch would be applied concurrently with seed on any steep slopes which are selected for hydroseeding. Nitrogen fertilizer may not be

applied during seeding but would be evenly broadcast over the soil surface early in the next growing season, since it is not required for seedling establishment but is necessary to enhance plant productivity. Vegetative characteristics such as vigor, color, growth rate, etc., would be monitored to determine soil fertility. If plant nutritional deficiencies appear, micronutrient testing would be conducted and appropriate measures taken to correct the problem.

4. Revegetation

a. Seed Mixtures and Rates

CIMC proposes to reestablish a post-mining grassland community with forested islands on the Yellowstone Mine area, based on post-mine site factors (aspect, topographic configuration, soils, etc.) and post-operational land uses. A permanent revegetation mixture for all disturbances is presented in Table 3. The revegetation mixture is primarily comprised of commercially available species documented as occurring in pre-mine vegetation types. The use of native species has been emphasized. Substitution of suitable species has been recommended where commercial availability is lacking or limited. As new releases of species are made, they would be considered for inclusion in the revegetation mix. Species evaluations would be made on reclaimed sites within the permit area throughout the life of the operation.

Seeding rates have been designed to total 90 to 100 pure live seeds (PLS) per square foot for drill seeding; the broadcast rate would be roughly twice that of the drill rate. Rates given for forbs are for a combination of any or all species listed (based on availability) to provide flexibility for the operator.

Table 3. Permanent Revegetation Mixture - Yellowstone Project

| | | Seeding Rate (PLS)[1] | |
|---|---|---|---|
| Species | Variety | Pounds/acre | PLS/sq.ft. |
| Grasses: | | | |
| Agropyron dasystachyum | Critana | 2.0 | 7 |
| Agropyron spicatum | Secar | 3.0 | 10 |
| Agropyron trachycaulum | San Luis | 2.0 | 7 |
| Elymus cinereus | Magnar | 3.0 | 3 |
| Festuca ovina | Covar | 3.0 | 10 |
| Oryzopsis hymenoides | Nezpar | 2.0 | 8 |
| Poa ampla | Sherman | 0.5 | 10 |
| Poa canbyi | Canbar | 0.5 | 10 |
| Stipa comata | | 2.0 | 8 |
| Stipa viridula[2] | Lodorm | 2.0 | 8 |
| | Subtotal | 16.0 | 80 |
| Forbs[3] | | | |
| Achilea millefolium | | | |
| Astragalus cicer | | | |
| Geranium viscosissimum | | | |
| Linum lewissi | Appar | | |
| Lupinus spp. | | | |
| | Subtotal | 0.5 - 2.0 | 10 - 20 |
| | Total | 16.5 - 18.0 | 90 - 100 |
| | Planting rate (stems/acre) | | |
| Shrubs and Trees: | | | |
| Ribes setosum | | 30 | |
| Rosa woodsii | | 30 | |
| Juniperus scopulorum | | 30 | |
| Pinus flexila | | 30 | |
| | Total Stems/Acre | 120 | |

[1] Rates given are for drill seeding; rates would be doubled for broadcast seeding.

[2] If available, Stipa occidentalis may be used as a substitute for s. viridula.
[3] Rate given for forbs is for a combination of any or all species listed.

All seed would meet requirements of the Federal Seed Act (7 U.S.C., Section 1551-161-, inc.) and meet the seed and noxious weed laws of Montana. Seed used would be certified and would have a minimum purity of 95.0 percent, minimum germination of 85.0 percent and maximum weed content of 0.5 percent.

b. Seedbed Preparation

Seedbed preparation would be conducted immediately after grading, soiling and fertilizer application. On gentle slopes (33 percent or less), the seedbed would be disced and harrowed along the contour to break up large clods. On slopes exceeding 33 percent or on sties too narrow to negotiate equipment, the soil surface would be left in a roughened condition. An irregular seedbed would provide microsites for plant germination and reduce soil movement on steeper slopes.

c. Seeding Methods

Seeding would be coordinated with other reclamation activities to occur as soon after seedbed preparation as possible. Seeding would normally be conducted in fall (after October 15) or spring (prior to May 1) depending on weather conditions. Spring seedings would be conducted as early in the season as possible to maximize use of early precipitation. Interim revegetation of sediment control structures, road cut and fill slopes, the facilities and office/shop areas and topsoil stockpiles would be conducted. Two methods of seeding would be employed: drill and broadcast. The majority of the disturbance area would be broadcast seeded or hydroseeded (dump faces, water control structures, road cuts and fills, etc.) due to steepness of slopes and/or relatively small acreage.

Drill seeding would be utilized on slopes less than or equal to 3h:1v; it would not be used on rocky surfaces. This technique results in proper depth placement of seed and promotes good contact between seed and soil. Drill seeding would be done along the contour wherever the surface is not level. Drill row spacing would range from 7 to 14 inches.

Broadcast seeding would be employed on rocky areas, on slopes steeper than 3h:1v and on small disturbances. Seed would be broadcast using manually operated cyclone-type bucket spreaders, a mechanical seed blower or hydroseeder. Seed would be frequently mixed to discourage settling. Where possible, broadcast seeded areas would be chained or harrowed to cover the seed. Where slope conditions allow, broadcast seeded areas would be dozer tracked perpendicular to the slope. On small or inaccessible sites, hand raking would be used to cover seed.

When hydroseeding is used, seed, fertilizer and mulch (about 250 pounds per acre) would be sprayed in one application. Where hydromulching is used, a second application would spray additional mulch and a tackifier (at the manufacturer's recommended application rates).

d. Plantings

Gooseberry, rose, juniper and limber pine would be planted at low densities in scattered islands at appropriate locations within the permit area. These species are present in the pre-mine environment; they would enhance stability, aesthetics and wildlife/livestock habitat post-operationally. Recommended planting rates are given in Table 4 but may vary depending on slope, aspect and moisture conditions. It is expected that a certain amount of natural regeneration of these species would also occur on those sites abutting existing stands.

The appropriate planting time would be determined by site conditions such as soil moisture, soil temperature, air temperature, aspect and accessibility. Generally, spring plantings are favored in this region. Spring planting must be initiated as early as possible (preferably in March or April) and end as early as possible. If accessibility becomes a problem, fall plantings would be practiced. Fall planting should be delayed until the planting medium is thoroughly moistened to a depth of one foot.

The decision to used containerized or bare-root stock would be based on species, site characteristics, growth medium and substrate, season of planting, availability and cost.

Stock would be delivered to the site as close to the time of planting as possible. No stock would be handled when the air temperature is below freezing and no plantings would be made when frost is in the soil. Planting would be accomplished using hand tools and power-driven augers or other machines, depending on size and condition of the planting area, type of stock and equipment availability. A 12- to 18-inch diameter planting site would be cleared to a depth necessary to position the seedling.

Mulching may be employed to conserve moisture and reduce competition.

The development of mycorrhizae on roots of forest trees is accepted as necessary for good survival and growth, especially in soils low in available nutrients. It is desirable to obtain stock raised in containers where the soil medium has been inoculated with mycorrhizae, if available. Competition between herbaceous vegetation and trees would be reduced by scalping; chemicals (if approved); mulching (including but not limited to straw, wood chips, rock, plastic, or paper); or by selective broadcasting of the herbaceous seed mixture. If tree seedling survival is less than 65 percent by year three of planting, DSL would be consulted to determine whether supplemental planting is necessary.

e. Mulching

Mulch would be evenly spread over the seeded area at rates dependent on seeding method and slope. Straw mulch would be applied at a rate of 0.5 to 1.0 tons/acre on drill-seeded surface and 1.0 to 1.5 tons/acre on steeper slopes where broadcast methods are used. Mulch would be anchored into the seedbed on slopes less than 3h:1v using a mulch crimper or disc. Hydromulch would be applied at a rate of one ton/acre. A tackifier would be used on hydromulched areas that are mulched in the fall and on areas such as road cuts and fills which require prompt stabilization.

f. Interim Revegetation

In order to reduce erosion and sedimentation during the life of the operation, certain disturbed areas would be vegetatively stabilized prior to final reclamation. These sites include road cut and fill slopes, topsoil stockpiles, surface water control structures and the facilities and office/shop areas. Soil would not be applied to temporarily revegetated areas. The sites would be broadcast seeded with species listed in Table 4. Mulch and fertilizer would be added as necessary. Interim revegetation would occur during the first appropriate season after construction is completed. Final reclamation would occur upon completion of the operation.

Table 4. Interim Revegetation Mixture - Yellowstone Mine

| Species | Variety | Seeding Rate (PLS)[1] | |
|---|---|---|---|
| | | Pounds/Acre | PLS/sq. ft. |
| Agropyon cristatum | Ephraim | 3.0 | 14 |
| Bromus Biebersteinii | Regar | 5.0 | 5 |
| Festuca longifolia | Duraf | 2.0 | 26 |
| Lolium multiflorum | | 1.0 | 5 |
| Poa pratensis | | 0.5 | 25 |
| Astragalus cicer | | 3.0 | 10 |
| | | 14.5 | 85 |

1 Rate given is for drill seeding

5. Erosion Control Procedures

a. Mine Area

i. Topography and Grading

- Waste rock dump sideslopes would be reduced to a 2h:1v slope by grading.
- Upon reclamation, the north waste dump top would be graded away from the dump face minimizing runoff over the steeper slope.
- Final grading and ripping would be conducted along the contour where possible.
- Slopes would be visually inspected periodically throughout the operation to determine evidence of slope failure.

ii. Soil Handling

- Soil would be handled only when it exhibits good tilth and is moderately dry to minimize compaction.

- Soil salvage would occur incrementally with disturbances to minimize the area exposed at any given time. This would reduce the length of time soil remains in stockpiles and reduce wind and water erosion associated with soil salvage.

- Once stockpiled, soil would not be disturbed until it is redistributed.

- Soil stockpiles would be located and protected to minimize wind and water erosion. Stockpile locations area away from drainages and on gentle slopes. Stockpiles are designed with 2.5h:1v sideslopes and would be revegetated for stabilization.

- Prior to soil redistribution, compacted areas would be ripped to eliminate potential slippage at layer contacts, promote root penetration and increase moisture penetration.

- Soil materials would be applied in lifts as thick as possible to decrease compaction.

- Respread soil materials would be sampled for macronutrient content to formulate fertilizer recommendations. If plant nutritional deficiencies appear, micronutrient testing would be included as part of the sampling program and appropriate measures would be taken to correct the problem.

iii. Revegetation/Cultural Treatments

Revegetation minimizes erosion, as previously described. Rapidly developing and sod-forming plant species have been included in the seed mixture to provide rapid stabilization. Seed purity and germination would be the highest available from plant material dealers with seed adapted to the geographical area in order to maximize establishment rates. Interim revegetation would be used to stabilize disturbed areas. Revegetation would occur in the first appropriate season after soil redistribution. Seeding methods would reflect slope and substrate conditions; drill-seeding would be utilized where possible and would be conducted on the contour. Cultural treatments would also be conducted on the contour wherever possible. Mulch (and tackifiers on hydromulched areas) would be applied to aid in erosion control and moisture retention. In addition, rills and gullies would be stabilized and revegetated, and revegetated areas would be protected from disturbance by banning traffic and livestock grazing until vegetation is established.

b. Roads

Erosion from roads within the permit area would be controlled by the diversion and sediment control structures for the mine. Since haul road bases would be constructed of

waste rock, minimal erosion is expected from road slopes. Haul roads would also have berms along the edges to prevent runoff. Openings in berms would be spaced to direct flows into the sediment control system.

Practices used to control erosion on roads include:

- Installing culverts and/or ditches designed for a 100-year, 24-hour precipitation event at locations determined by final road design.
- Periodic maintenance of culverts.
- Resoiling and revegetating cut and fill slopes during the first appropriate season after construction.
- New construction would be designed to disrupt natural drainage as little as possible.
- Erosion bars would be constructed as necessary after operations have been completed.
- Road maintenance would be designed to minimize sedimentation.

The Johnny Ridge Road would be maintained by the USFS after cessation of CIMC operations.

6. Pit Hydrology

Based on operating experience at the Yellowstone Mine, pits are free-draining and are not expected to hold water after operations cease.

7. Stability

Pit, waste dump, and tailings impoundment stability are not expected to be problems at the Yellowstone Mine. Waste dump slopes would be graded to substantially less than the angle of repose. Soil salvage would remove soils down to a coarse, fragmented bedrock that would provide a stable base for dump construction. Revegetation of dump slopes, grading the top to avoid drainage over the face, and steepness of the slopes would minimize the potential for saturation of the dumps. The waste material is coarse and free draining, which would prevent buildup of a phreatic surface within the dump.

Final pit wall angles would be 65 degrees; overall slope of pit walls would be 46 degrees. It is expected that some ravelling would occur, thereby causing catch benches to partially fill. Large-scale pit wall failure is not expected.

Tailings impoundment stability is addressed in the Operating Plan.

Instability resulting from wind and water erosion is expected to be minimal. Methods to control erosion have been previously stated in this plan.

8. Facilities Removal

After mining, ore processing, and loadout operations are completed, all buildings and related equipment and infrastructure would be dismantled and removed. Cement slabs would be cracked for drainage. Inert waste from the office/shop area would be placed in the gravel pit and buried. Inert waste form the facilities area (sorters and mill) would be buried during final grading of the waste rock dumps. The facilities area and office/shop complex would be graded, resoiled and revegetated as outlined in this reclamation plan.

9. Solid Waste Disposal

Following removal and salvage of facilities, any remaining solid waste would be disposed of in accordance with laws and regulations of the Montana Solid Waste Management Bureau and Madison County. Inert waste such as steel, concrete, plastic or wood would be buried in on-site waste disposal areas or sold to scrap dealers for recycling; some waste may be transported to an approved waste transfer station as authorized by the county solid waste district. No hazardous or toxic waste would be present in the mining, ore processing or handling activities. No post-mining problems are anticipated from solid waste, and any on-site burial would be coordinated with appropriate agencies.

10. Monitoring

a. Revegetation

Revegetated areas would be evaluated by field reconnaissance during the first season following seeding to determine initial revegetation success. Monitoring would include a qualitative evaluation of cover and species composition. Areas with poor germination and/or growth would be noted and evaluated to determine probable causes. CIMC would seek the advice of the DSL to determine the scope of the evaluation. It would conduct such evaluations as necessary, revise reclamation techniques to address any identified problems, and make a second attempt to revegetate problem areas.

As stated previously, it is anticipated that revegetation mixtures proposed in this reclamation plan may be modified, after agency approval, to reflect plant material availability and other factors. Of prime importance to changing seed mixtures and rates would be the evaluation of initial revegetation success.

All revegetated areas would be evaluated qualitatively on an annual basis to assess potential weed populations. A weed control plan would be developed in cooperation with the Madison County Weed Control District.

b. Soils

CIMC would sample soil materials respread from soil stockpiles for macronutrient content to formulate appropriate fertilizer recommendations.

When formulating fertilizer recommendations, species nutrient requirements would be taken into consideration. Post-seedling emergence would be observed to monitor soil fertility. If plant nutritional deficiencies appears, micronutrient testing would be included in the sampling program and appropriate corrective measures would be taken.

c. Stability

Pit wall, waste dump, and tailings impoundment stability would be monitored continuously throughout the operation. Any post-operation stability problems would be avoided by slope reduction on waste dump sideslopes and pit wall reduction during operations if major instabilities develop using designed slopes.

Reclaimed slopes would be inspected in spring and fall for rills and gullies and for evidence of slumping, cracking or mass movement. Damage to the reclaimed surface from erosion would be repaired by regrading, installing temporary flow restrictors (such as straw bales) and reseeding to establish vegetation. Erosion control measures such as jute netting, erosion control blankets, or other means may be utilized if site conditions require.

11. Management

a. Protection of Regraded Areas

Final grading and soil replacement would be done along the contour to minimize erosion. If rills or gullies form in graded and soiled areas, they would be filled, graded, or otherwise stabilized and the area would be reseeded. Surface water control structures would be maintained until areas are stabilized to prevent excessive erosion and sedimentation.

Vehicle traffic would be excluded from reclaimed areas and no livestock grazing would be allowed for at least two years after seeding. Livestock access to revegetated areas would be controlled by fencing the perimeter of disturbed areas if necessary. Wildlife damage would be controlled as necessary by selective fencing or chemical repellent.

b. Noxious Weed Control

Two noxious weeds listed by the Montana County Weed Control Act (MCA 7-22-2101 through 2153) were recorded within or adjacent to the permit area: Canada thistle and spotted knapweed.

Noxious weeds on CIMC-controlled property would be controlled throughout the life of the operation to reduce the seed source available to invade reclaimed areas. Revegetated areas would be qualitatively evaluated annually to assess weed populations. A weed control

plan would be developed in cooperation with the Madison County Weed Control Board. Forbs would be deleted from seed mixes if spraying is necessary on revegetated areas.

Monitoring and control of weeds on both rangeland and reclaimed areas and revegetation practices discussed elsewhere in this plan would effectively limit weed populations.

c. Water Control Structures

Upon completion of mining, a surface water drainage system would be in place that would minimize erosion and allow runoff to efficiently pass through the reclaimed area. The final post-mining drainage plan would incorporate experience gained during operations to make any necessary modifications to the operational runoff control system.

Sedimentation ponds would be left in place after reclamation has been completed for livestock and wildlife use. Buried pipelines and well casings would remain in place.

It is expected that all surface water from the reclaimed areas would meet the requirements of the Montana Water Quality Act and Montana's Surface Water Quality Standard. No treatment of surface water in the permit area would be required.

It is similarly expected that post-mining groundwater quality would be unchanged from its pre-mining condition and would meet water quality requirements of the State of Montana. The post-mining groundwater conditions in the vicinity of the mine pits would be similar to the existing system. Other than temporary runoff, water is not expected to accumulate in any of the pits.

d. Access Road

Maintenance of the access road would be conducted by CIMC during operations. Following operations, maintenance of sections shown on Figure 2 would revert to Madison County and the U.S. Forest Service.

e. Post-Operation Management

It is not anticipated that any special post-operation treatments would be necessary to achieve reclamation objectives. No irrigation, interseeding or other treatment is proposed. Normal range management practices would be used as necessary to enhance the value of revegetated areas.

12. Reclamation Schedule

Two basic types of reclamation would be conducted: interim reclamation to meet short-term objectives (primarily erosion control) and final reclamation to meet long-term land use objectives. Interim reclamation would be conducted throughout the operation to stabilize disturbed areas that would be redisturbed at some point in the operation. Examples include soil stockpiles and sediment control structures. Interim revegetation would not be conducted

where rock provides acceptable erosion control. Interim reclamation would occur during the first appropriate season after construction or establishment. Final reclamation on these sites would occur upon completion of the operation.

Final reclamation would occur during two time periods: life of operations and post-operations.

During the life of mine, final reclamation would be conducted on those disturbances that would not be redisturbed by future activities. Since this plan addresses eight years of activity with additional mining likely, it is premature to identify sites that may be reclaimed during operations. As additional geologic data and mine plan information becomes available, CIMC would develop and implement a schedule to reclaim those sites that would not be disturbed by future activities.

Final reclamation occurring after cessation of operations would include all disturbances not previously reclaimed. Final reclamation would be completed within two years after mining is completed.

Exploration trenches and trails in the office/shop complex area were reclaimed during 1989. Cut-and-fill slopes on the Johnny Ridge Road were seeded during 1989. The buried freshwater pipeline will be reclaimed during 1990.

Reclamation evaluations would be important in determining the applicability of practices include din this reclamation plan. Evaluation of 1989 revegetation would be important in determining whether modifications to the plan are desirable.

13. Cessation of Operations

a. Temporary

Although a temporary cessation of operations is not planned, circumstances beyond the control of CIMC may cause a short-term hiatus in operations. Temporary cessation refers to the suspension of ore processing for an anticipated period of one year. If a temporary shutdown occurs, the following actions would be implemented:

- Clear and repair site drainage and sedimentation control structures to ensure proper runoff and sedimentation control over a sustained period of time. Areas susceptible to erosion would be contoured and seeded.
- Maintain access road to ensure project access.
- Inspect signs and fencing around the property; repair or replace as necessary.
- Develop a program for facility inspection and implementation.

- Conduct seeding and associated revegetation practices on areas not planned for additional disturbance, except for sites where rock provides adequate erosion control.

- Continue to control noxious weeds.

- Continue dust suppression activities (sprinkling) on any exposed tailings.

No actions would be taken, however, that would preclude a resumption of operations.

b. Permanent

A permanent cessation of operations would result in the unlikely event that operations ceased prior to the end of scheduled operations. In this case, pit size, waste rock dump size, and tailings impoundment size would be less than proposed. Reclamation objectives and methods would be the same as presented in this plan. A major difference (in addition to less disturbance) would be post-operation land configuration; this would vary depending on when operations ended. If operations were to end prematurely, CIMC would prepare, in association with DSL, a reclamation plan to address conditions as of the cessation.

J. Consequences of the Company's Proposed Action

1. Introduction

CIMC has provided a comprehensive operating and reclamation plan for the entire Yellowstone Mine complex and an outline of potential future options at the site as well as potential relations with the Montana Talc Company's Johnny Gulch Mine. At the present time, mine disturbances from 1950 through 1970 are not covered by a reclamation plan as they occurred before the passage of the Metal Mine Reclamation Act in 1971. Mine disturbances under Operating Permits 00005 and 00005A between 1971 and 1986 are covered by an outdated general reclamation plan developed in 1971 with passage of MMRA. Amendments passed in 1986 and 1988 under operating permit 00005A have reclamation plans for the new disturbances that are adequate and have been outlined in DSL's Preliminary Environmental Reviews (PER) in 1986 and 1988.

As a result of this amendment application, the entire mine operation associated disturbances from 1950 to 1996 would be covered and bonded adequately. Following is a summary of reclamation for the mine complex.

a. Reclamation Summary

The permit area encompasses about 1,223 acres, of which approximately 540 would be disturbed. Table 5 lists type of disturbance, acreage disturbed and general reclamation. For some disturbances such as bone stockpiles, reclamation options (presented in the Reclamation Plan) would be dictated by economic and operational considerations. Worst-case options are included, but would not be implemented unless necessary. The Johnny Ridge road is not included within the permit area as it would provide access to public lands and

would remain after mining has ceased. Operational reclamation of the access road has been included in the application, however, to address procedures to control erosion and revegetate cut-and-fill slopes.

Table 5. Type of Disturbance, Acreage, and Proposed Reclamation, Yellowstone Mine

| Type of Disturbance | Size of Disturbance (acres) | Reclamation |
|---|---|---|
| Pits (four) | 102.1 | Berm pit perimeters, backfill if feasible |
| Dumps | | Slope reduction, resoiling, revegetation |
| Waste rock (two) | 125.4 | |
| Pit sorter (two) | 23.3 | |
| Bone stockpiles (two) | 35.8 | Bone processing, slope reduction, resoiling, revegetation |
| Facilities | | Structure removal, grading, resoiling, revegetation |
| Sorter (mechanical) | 4.5 | |
| Flotation | 6.8 | |
| Shed sorter/training room | 0.4 | |
| Tailings impoundment | 12.9 | Buried by future pit sorter dump |
| Soil storage areas | 19.3 | Ripping, revegetation |
| Water control structures | 1.2 | Backfilling, resoiling, revegetation |
| Water line | 3.8 | Buried line resoiled, revegetated |
| Office/shop complex | 7.3 | Structure removal, grading, ripping, revegetation |
| Abandoned Johnny Gulch road | 5.6 | Grading, ripping, resoiling, revegetation |
| Miscellaneous associated disturbances[1] | 192.0 | Grading, (ripping), resoiling, revegetation |
| **TOTAL DISTURBANCE** | 540.4 | |

[1] areas adjacent to listed disturbances where soil materials have been salvaged to accommodate operational design, as well as permit area roads (excluding in-pit roads and post-operational access road).

b. Issues Identified in EA Process

Consequences of the company's proposed action would only address issues identified in this amendment review process. Those issues involve the adequacy of the rock drain in

Johnny Gulch and the effects of the proposed tailings impoundment in Johnny Gulch on the integrity of the rock drain. The agencies have expressed concern over the cumulative effects of Montana Talc Company's operations on overall rock drain function. The agencies asked for a detailed characterization of the hydrologic system in Johnny Gulch to enable a review of the cumulative effects of all operations on the rock drain. The only additional issue addressed in the review process of consequence had to do with the use and fate of reagents to be used in the recovery of talc in the flotation mill which would end up in the tailings impoundment.

2. Issues Identified in Review Process

Issue 1 - Characterization of the Hydrologic System in Johnny Gulch

The Johnny Gulch area is underlain by colluvial material overlying Precambrian dolomitic marbles. Locally, the colluvial material may be underlain by volcanic ash. Groundwater movement in the Johnny Gulch area is in response to local fractures and fault systems. The low precipitation and poor infiltration rates of the local material suggest that water exiting the Johnny Gulch system would probably do so via surface flow or subsurface return flow.

However, CIMC could not find a continuous groundwater system in the colluvial material or immediately underlying bedrock in Johnny Gulch. Based on the evidence it appears that the gulch is a losing portion of the drainage for both surface water and groundwater flow. The seasonal surface flow in Johnny Gulch is almost entirely lost to seepage at about the location of the proposed tailings impoundment and a water table condition has not been identified in the colluvial material in the gulch or the immediately underlying bedrock.

During the 1986 - 1990 period, fifteen drill holes in Johnny Gulch failed to detect a water table condition. Of these holes, three penetrated the colluvium and several hundred feet of bedrock, nine penetrated the colluvium to the bedrock surface, and two penetrated the colluvium but did not reach bedrock. The agencies are concerned that if water of poor quality leaves the site, it would not be able to detect the critical flow path and ultimate fate of the water. The agencies asked for information on seepage water quantity and quality and more monitoring information.

3. Issue 2: Additional Monitoring Well and Impoundment Seepage Characterization

a. Quantity of Impoundment Seepage

Utilizing permeability of the tailings and area of the unlined pond to predict the flow rate in the underdrain should result in an exceedingly large overestimation. Based on a hydrometer gradation of a composite tailings sample from metallurgical testing, the $d_{10}$ size for the mill run tailings is approximately 0.02 mm. Therefore, using Hazen's equation to calculate permeability (K cm/sec = $d_{10}$ mm)$^2$ results in a tailings permeability of approximately $1 \times 10^{-4}$ cm/sec or approximately $2 \times 10^{-4}$ ft/min. From Figure 6, the unlined

area of the proposed tailings pond is approximately 270,000 $ft^2$. If it is assumed the tailings are always submerged, there is a constant supply of water at a rate at least equal to the calculated seepage rate, and the foundation is more permeable than the tailings (all head is lost in the tailings), and all seepage loss from the pond goes to the underdrain, then Darcy's Law ($Q=kiA$) with a gradient of 1.0 may be used to estimate seepage loss from the pond to the underdrain. This results in a calculated seepage loss flow in the underdrain for the end-of-life condition of approximately 400 gpm. However, none of the above assumptions, with the possible exception of foundation permeability, are considered applicable to the proposed tailings facility and the 400 gpm flow rate in the underdrain predicted by this model is considered excessive.

In order to maintain complete submergence of the tailings, the tailings area would require a geometry allowing ponding throughout the entire facility and water input greater than the sum of all water losses. Introduction of tailings in the upper portion of the area would result in a tailings beach sloping toward the South Waste Dump embankment where free water would be impounded and reclaimed for the mill; therefore, unless water enters the pond from the precipitation/evaporation cycle, complete submergence of the tailings should not occur. Based on published information, the tailings site is expected to receive 16 to 20 inches annual average precipitation, estimates an annual evaporation of approximately 35 inches. This results in a net annual excess evaporation condition in the tailings facility.

The design flow rate from the mill to the tailings pond is 134 gpm. Therefore, in the absence of a net precipitation condition, this rate should be the upper limit of possible seepage loss.

The seepage analysis based on area and tailings permeability assumes the foundation to be a free-draining material with a permeability much greater than the tailings. This is required to meet the analytical condition of a constant zero head in the foundation below the tailings, resulting in total head loss across the tailings. Although direct measurements of the foundation permeability have not yet been undertaken, the near surface tertiary volcanic and dolomitic bedrock combined with clayey tertiary volcanic fraction in the colluvial mantle should make the general foundation permeability at most equal to that of the tailings and perhaps one or two orders of magnitude less. These conditions should result in an actual seepage loss much less than that calculated based only on area and tailings permeability.

All pond seepage need not flow to the engineered rock underdrain. Assuming the bedrock is tighter than the colluvium, most seepage should report to the combined rock drain/colluvium unit and move downgradient along the colluvium/bedrock contact.

Based on comments above, seepage from the tailings area to the rock drain/colluvium unit is estimated using an effective free water pond area of 100,000 $ft^2$, an effective average permeability of $2x10^{-5}$ ft/min, and a gradient of 1.0. This results in a calculated seepage flow rate of approximately 15 gpm in the rock drain/colluvium unit beneath the tailings facility.

b. Quality of Seepage

Quality of seepage is assumed to be equivalent to the mill water in the tailings slurry. Mill water would originate from the make-up well system located in Ruby Creek south of the project site. Baseline chemistry of this water is given in Appendix II-4 of CIMC's application, 1987. The talc beneficiation process proposed is a combination of flotation to separate talc from the gangue minerals (primarily dolomite and quartz), with subsequent bleaching of a portion of the recovered talc to remove iron and raise the talc brightness.

The waste rock is basically inert and would not cause any chemical limitations to revegetation or cause acid runoff. No chemical problems have been identified to date (since 1950) at the Yellowstone Mine. The primary constraint to revegetation is the high coarse fragment content of the waste resulting in very low moisture holding capacity. The low moisture holding capacity of the waste rock would be mitigated by applying coversoil to the dump surfaces.

The tailings would consist of fine (-60 mesh) material chemically similar to waste rock. The solid particulate of the tailings should contain 75-85 percent dolomite, 15-25 percent talc, 0-2 percent chlorite and 0-2 percent quartz.

The flotation process uses water from the Ruby Creek well system with the addition of methyl isobutyl carbinol (MIBC) as a frothing agent. The flotation circuit operations at the natural pH of the system. The Ruby Creek water has a pH of 7.8 to 8.0 (Appendix II-4, CIMC, 1987). The ore feed is primarily a mixture of dolomite, talc and quartz and the dolomite will serve to buffer the system, maintaining a pH of approximately 8.0 throughout the flotation and tailings water systems. Therefore, no dissolved heavy metals are expected to occur in the flotation circuit. The MIBC, an alcohol widely used throughout the mining industry as a frother, serves to enhance the creation of bubbles in the flotation cells and promote talc flotation. the MIBC is added to the mill feed at a rate of 0.06 lbs/ton of ore. The MIBC, much lighter than water (specific gravity = 0.8) and only slightly soluble in water (Appendix II-3), would primarily travel with the talc product stream to the bleaching and/or drying circuits rather than with the tailings stream. The mill designers estimate that five percent of the MIBC may travel with the tailings stream and that none of the MIBC could survive the bleaching circuit (Ray Hyyppa, Johnson-Hyyppa, personal communication). Assuming no other losses due to volatilization or oxidation, the MIBC concentration in the tailings water would be approximately 2 ppm. This level of MIBC is well below the toxicity limits published in the Material Safety data Sheet (Appendix II-3, CIMC, 1987), and is less than one percent of the LC50 level of 460 ppm for fathead minnows provided by Union Carbide (Union Carbide, personal communication). Based on this information, MIBC is not considered to threaten beneficial use of the water resource in the area.

The bleaching circuit uses $SO_2$ gas and zinc dust at a hydrochloric acid-maintained pH of 2.5 to remove iron from the talc and raise its brightness. The raw bleach liquor is expected to have very high concentrations of dissolved zinc, chloride, and sulfate along with the iron and other minor impurities removed from the talc. Because the raw bleach liquor is totally unsuitable for discharge to the tailings facility, it would be treated with lime to adjust the pH to 8.0 and precipitate the dissolved metals.

The chemistry of the neutralized bleach liquor has been analyzed for primary parameters introduced during the bleaching process, indicating the following concentration ranges: 0.21 - 0.22 ppm zinc, 290 - 309 ppm chloride, 90 - 185 ppm sulfate. The treated bleach liquor is diluted approximately 44 percent in the tailings thickener, giving a resultant tailings effluent of approximately 0.12 ppm zinc, 172 - 173 ppm chloride, and 50 - 104 ppm sulfate.

In the absence of an identified receiving water, and since drilling to approximately 300 feet beneath Johnny Gulch has failed to encounter a water table and historical experience indicates no surface water is discharged from the site, CIMC believes that seepage from the tailings facility would not impact water resources in the area.

Assuming the tailings are suitable for discharge to the proposed tailings facility, the operating condition (with continual input of tailings water from the mill) should represent the most critical phase of the project with regard to water quality. High buffering capacity of the finely divided dolomite tails, gradation of the tails, and low precipitation in the area combined with the reclamation plan should preclude development of a poor quality leachate following reclamation of the tailings facility.

Because of the unknowns, the agencies have asked for an additional monitoring well below the impoundment and additional water quality monitoring to identify potential impacts from impoundment seepage. CIMC may also switch to a sodium compound if zinc is found to be a problem in the monitoring as zinc has a maximum contamination level of 5 ppm, CIMC is to establish the following operational water quality monitoring stations and sample report at the given intervals:

| Station | Location | Sample Interval |
|---|---|---|
| TA-100 | Tailing Thickener Outfall | Monthly/MIBC Quarterly |
| JG-500 | Johnny Gulch Rock Drain | Observe Monthly/Sample Quarterly |
| JG-300 | Johnny Gulch Colluvium Well | Observe Monthly/Sample Quarterly |
| JG-100 | Office/Shop Well | Quarterly |

Note: "Monthly/MIBC Quarterly" indicates the station would be sampled monthly for pH, nutrients, common ions and trace metals and quarterly for MIBC.

Note: "Observe Monthly/Sample Quarterly" indicates the station would be observed for water on a monthly basis and sampled the first time water is observed in each quarter. If no water is observed in a quarter the station would be reported as dry for the quarter.

The Johnny Gulch Rock Drain (JG-500) and Colluvium Well (JG-300) are to be located at the downstream toe of the South Waste Dump. The Rock Drain station would sample water exiting the rock drain at the ground surface. The Colluvium Well would be a monitoring well installed to bedrock to sample water in the colluvial material in Johnny Gulch. The Office/Shop Well (JG-100) is the existing potable water well located at the Office/Shop complex at the extreme east limit of the permit boundary.

All samples would be analyzed for dissolved constituents using the following parameter list and detection limits.

| Parameter | Detection Limit |
|---|---|
| pH | ± 0.1 units |
| Nitrate + Nitrate as N | 0.05 ppm |
| MIBC (TA-100 only) | 5 ppm |
| Common Ions: | |
| Chloride | 1 ppm |
| Sulfate | 1 ppm |
| Zinc | 0.02 ppm |

Note: MIBC would be sampled and analyzed quarterly from Station TA-100 only.

4. Issue 3 - Potential for the Tailings Impoundment to Influence a Failure of the Rock Drain

a. Description of Tailings Impoundment and Its Relation to Drain Function

Reclamation of the tailings impoundment is described elsewhere in more detail; however, the basic reclamation plan involves capping the tailings with waste rock, resoiling, and revegetating the area. The rock drain, engineered under both the tailings and the rock dump, would be protected from infiltration of tailing fines by a geomembrane.

The proposed tailings impoundment can influence performance of the rock drain. The drain could be come clogged by tailings material which could possibly result in the loss of flow capacity of the rock drain. Clogging by tailings material, if left unmitigated, would present the only direct threat to the rock drain. For this reason, the tailings impoundment design incorporates a cushion-protected geomembrane to prevent the tailings from migrating into the rock drain from the tails placed directly above the drain and from migrating into the waste rock dump which forms the embankment for the tailing impoundment. The geomembrane would assure the long-term functioning of the rock drain and would maintain flow through the rock embankment from the tails.

b. Flow Capacity

Possible loss of flow capacity above the rock drain would not directly impact the rock drain. Rather, it would be an unquantified loss of additional flow capacity of Johnny Gulch. This capacity would have been available if the tailings were not placed upgradient of the rock dump. The rock drain is designed to pass 150 percent of the 100-year flood flow without relying on additional capacity in the tails and the dump, above the drain. The design capacity is considered adequate protection against drain failure.

### c. Drain Size and Design Considerations

The proposed South Dump expansion would fill Johnny Gulch. The proposed dump design incorporates an empirically-sized underdrain system to allow for the passage of flows generated from a 100-year, 24-hour rainfall event which are estimated to be 75 cfs. The permeability of the underdrain is derived from empirical methods and assumed parameters. Constructing an underdrain with a cross-sectional area that is larger than that required to handle the calculated flow capacity of the drain accounts somewhat for the empirical margin of error and the unpredictability of natural phenomena. This cross-sectional area would provide a design permeability of 1½ times that required to pass the flow rate for a 100-year event.

The underdrain piping requirement, normally an essential component of engineered rock drains, was not incorporated into the design because: 1) Johnny Gulch is an ephemeral drainage with infrequent runoff events, 2) the waste rock is free draining, and when end-dumped onto the drain, would tend to gravity segregate and provide additional permeability above the rock underdrain, and 3) the foundation material is coarse angular colluvium with few fines, relatively thin to bedrock, and not considered conducive to extensive migration from piping.

The infiltration of water into the waste rock dump would reduce the volume of water available for either runoff or infiltration into the original underlying drainage bottom in the short term. This reduction in volume is due to the necessity of establishing a certain amount of interstitial water before flow can be transmitted. This reduction in flow may occur when evaporation reduces the interstitial water significantly. The dump would reduce storm flows as water infiltrates the dump and is held in place, thus providing for long-term irretrievable water storage. The placement of waste material in Johnny Gulch would alter the infiltration/runoff relationship in the area by removing areas that previously either contributed runoff or allowed for infiltration.

### d. Cumulative Effects

Both CIMC and Montana Talc Company have proposed to dispose of waste material in the Johnny Gulch drainage. These dumps cumulatively would fill approximately one mile of the Johnny Gulch drainage with waste material. Even with the use of empirically-sized engineered drainage structures under the waste facilities, it is likely that a reduction in the flow capacities of these structures would take place in the future. The long-term consequences of this reduced capability would vary with the magnitude of the storm event, and that ability of the surrounding dump material to transmit flow. Expected consequences range from minimal impact (under low flows and high permeability of the surrounding material) to the impoundment of water within the system which could, if suddenly released, cause minor flooding offsite. The end-dumped waste material is relatively coarse and is free-draining, indicating that high runoff flows may be transmitted by the material surrounding the underdrain. When flows in excess of the capability of the system take place, it is anticipated that ponding would develop at the initial underdrain inlet and that the emergence of peripheral springs and seeps would likely occur.

Rock drain malfunction in the future could be aggravated by Montana Talc Company's plans for flotation at the mine site or the need for CIMC to raise the impoundment for 22 more years of additional tailings storage.

Additional drainage would be filled with tailings material. In addition to the tailings currently proposed for placement, CIMC may propose to enlarge the tailings impoundment some time after 1996.

If CIMC makes such a proposal, the proposal would be evaluated pursuant to MMRA and MEPA.

## CHAPTER IV - ALTERNATIVES

This chapter identifies and evaluates alternatives to the proposed plan including (1) the proposed plan with modifications, (2) denial, and (3) alternatives dropped from further analysis.

### A. Company's Proposed Plan with Modifications

The application review process identified several issues as worthy of additional consideration. The issues dealt with the characterization of the hydrologic system in Johnny Gulch, seepage water quantity and quality from the impoundment, and the cumulative effects of the proposed and future tailings impoundment development from CIMC and Montana Talc Company on rock drain function.

CIMC has responded and modified their proposed plan to address some of the issues. Some of the outstanding issues were resolved in a letter sent to DSL on January 25, 1990 (see Appendix A), in which CIMC listed three stipulations that DSL will attach to the permit dealing with:

1. Increased definition of the alluvial/colluvial hydrologic system in Johnny Gulch;

2. Contingency plan should tailings seepage water appear in the proposed Johnny Gulch monitoring well; and

3. Additional upstream monitoring well.

As a result of CIMC's responses in the review process and the limited amount of new disturbance, the regulatory agencies have not identified additional alternatives that need to be considered.

The stipulations would not reduce the overall impact of the proposed plan. However, the stipulations, when implemented, would result in data which presumably would verify the assumptions regarding impact If assumptions were not verified by the data, the data would allow the department and CIMC to implement alternative reclamation measures. The contingency plan required by stipulation 2 would identify the measures to be used.

### B. Denial of the Proposed Action

Denial of the proposed action would leave the permit area with a reclamation plan and operating plan that are outdated and underbonded. The agencies believe this would be a mistake as CIMC has voluntarily agreed to reclaim and bond mine disturbances from 1950 through 1970 which are grandfathered under the Metal Mine Reclamation Act.

In addition, if the permit were denied, 165 employees would be laid off, creating an economic impact in the area from Three Forks south to the communities along U.S. Highway 287.

## C. Alternatives Dropped from Further Consideration

Four potential tailing sites were considered prior to selecting the proposed Johnny Gulch location. They were: (a) top of the South Waste Dump, (b) the small draw immediately southwest of the proposed Johnny Gulch tailings site, (c) the inactive South Main Pit, and (d) the proposed site in Johnny gulch. The site on the top of the South Waste Dump was rejected due to stability concerns regarding construction of a tailings impoundment on the dump and, in comparison to the proposed location, the need to construct a containment dike that could not possibly provide the equivalent stability afforded by complete tailings retention behind the South Waste Dump. The small draw immediately southwest and tributary to Johnny Gulch was rejected because it is too small to contain the proposed tailings production. The inactive South Main Pit was rejected because a suitable site was available without abandoning the opportunity of further mining on the South Main Pit.

## CHAPTER V - RECOMMENDATIONS AND CONCLUSIONS

The potential for impoundment and/or sudden release of water and the potential for undetected seepage of unknown quality and quantity from the proposed tailing impoundment have been the major issues identified in the environmental assessment process. Cumulative effects of future impoundment expansion by CIMC and/or Montana Talc Company threaten the capacity of the non-engineered rock drain to carry design flow volumes in perpetuity.

The rock drain was originally designed for a road crossing with a cross-sectional area of 2,100 square feet of drain and the design incorporated a factor of safety about three times the calculated design flow. The rock drain was considered appropriate and permitted because the design accounts for the permeability requirement only, and disregards the equally important piping requirement that is necessary for an engineered rock drain that is expected to function permanently. The justification for conservative design due to the degree of risk and variability of the assumptions is indicated in the original design report.

The design was subsequently revised by CIMC in 1988 to extend the length of the drain so that Johnny Gulch could be filled with waste rock, while the cross-sectional area of the drain was reduced to 1,350 square feet with a factor of safety for calculated permeability of 1.5. At that time, the reduced drain design and increased length was intended to carry floodwaters only.

The Montana Talc Company also used the reduced cross-sectional area and permeability capacity in their waste rock drain calculations which were permitted in 1988.

Now, CIMC proposes to build a tailing impoundment over the drain which was not designed considering this use in the eight-year plan and the possibility of future expansions for another 22 years after that. The possibility also exists that Montana Talc Company could add a tailing impoundment at their mine site.

Regardless of the calculated impoundment seepage, limited potential for contamination of the drain by transportation of fines, or the operational suitability of the site, the regulatory agencies must consider the incrementation of drain design and function as retrogressive.

Minor amounts of ponding and the development of seeps and springs at the dump toe can be expected as drain function deteriorates. The potential exists for a sudden release of water in a major storm event over the top of the waste rock dump but the amount of waste rock in Johnny Gulch would preclude typical embankment stability failure.

The regulatory agencies have concluded that the effects of the plan as proposed would not be significant and, therefore, an environmental impact statement is not needed on the proposed amendment. Several additional stipulations will be attached to the permit to help mitigate any possible effects in the drainage.

# CHAPTER VI - CONSULTATION AND COORDINATION

## A. Consultation

The following personnel in various agencies, companies, and organizations provided information to the DSL and the BLM which was used in the preparation of this EA:

| | |
|---|---|
| Department of State Lands | Patrick Plantenberg<br>Pete Strazdas<br>Terry Webster<br>Craig Pagel<br>Bob Winegar |
| Cyprus Industrial Minerals Company | Bob Pineazkiewicz<br>Russ Leonard |
| Water Quality Bureau | Larry Brown |
| Bureau of Land Management | Dave Williams<br>Ken Thacker |
| U.S. Forest Service | Dale Ragain |
| Montana Talc Company | |
| State Historic Preservation Office | |
| Westech, Inc. | Ken Scow<br>Lisa Larsen<br>Dean Culwell<br>Duane Noll |
| Chen-Northern | Dale Ortman |

## B. Public Involvement

The mine and mill are subject to a grandfather clause in the MMRA. CIMC has applied for and received six amendments. Public comments were requested for an Environmental Assessment on Amendment 002. Public comments were not received. Comments on Amendments 3 through 6 have not been received.

Lack of significant environmental impacts probably accounts for lack of public interest.

## CHAPTER VII - GLOSSARY

bone material - waste that contains quartz mixed with ore.

cleaner - object or machine used to upgrade a product.

feed - that raw material that is put into the benefication plant to be concentrated or upgraded.

frother - reagent used to float a mineral during benefication.

interstitial - void spaces relating to or situated within or between mineral grains or composite solids such as mill tailing or soil material

scalper - object or machine to produce a rough concentrate requiring a cleaning or upgrading before the final product.

sump - a collection area for solutions or slurried materials.

underdrain piping requirement - filter fabric or gradational rock filters around rock drain to keep fine material out of rock drain.

# APPENDIX A - JOHNNY GULCH HYDROLOGIC SYSTEM